SCIENCE

NEW SERIES. VOLUME XLVII

JANUARY-JUNE, 1918

NEW YORK
THE SCIENCE PRESS
1918

THE NEW ERA PRINTING COMPANY,
41 North Queen Street,
Lancaster, Pa.

CONTENTS AND INDEX.

NEW SERIES. VOL. XLVII.—JANUARY TO JUNE, 1918

THE NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

SCIENCE

Friday, January 4, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME ECONOMIC ASPECTS OF THE WORLD WAR[1]

ECONOMIC CONDITIONS BEFORE THE WAR[2]

Our Resources

The United States is a nation of unmatched natural resources. It is a young nation. Its people have not yet multiplied so that they even approximate the potential possibilities of production. In consequence of this happy situation the United States, antecedent to the war, easily produced a sufficient amount of almost every essential commodity to meet our wants and in addition a large surplus. The production in the United States of the cereals—wheat, oats, rye, corn, and barley—was enormous. Whether the year was favorable or unfavorable, enough of each was produced not only for our own needs, but these commodities could be shipped abroad to any extent that the market demanded.

The situation in regard to meats and fats was like that which obtained for the cereals.

The only fundamental food of which we did not produce vastly more than we needed was sugar; and an adequate supply of this commodity was easily furnished by our insular possessions and by our immediately adjacent neighbor Cuba.

The two great textiles of the world are cotton and wool; and of these "cotton is king." Of the latter commodity the out-

[1] Address of Charles R. Van Hise as retiring president of the American Association for the Advancement of Science, Pittsburgh, Pennsylvania, December 28, 1917.

[2] For a much fuller presentation of the facts herein summarized see "Conservation and Regulation in the United States during the World War," by Charles R. Van Hise, published by the Food Administration.

put of the United States was more than twice that of the rest of the world; and wool was also produced in large quantities; but for this textile, we were both exporters and importers.

Of the most essential mineral products. we were leaders of the world. More iron ore and its products, iron and steel, were produced in the United States than by our two chief competitors combined—Great Britain and Germany.

Similarly the production of copper was more than half that of the world. For lead and zinc we led the world. The petroleum production again was more than half that of the world.

Fundamental to all industry is power; and power is mainly produced by coal and falling water. The coal production of the United States previous to the war was greater than that of Great Britain, Germany and France combined; and water power was developed on a more extensive scale than in any other country.

Also the forests of the United States originally surpassed those of any other country; indeed wood was so abundant that except in the cities we are a nation of wooden houses.

Finally the transportation system of the United States has developed far beyond that of any other country. The railroad mileage of the United States for 100,000,000 people is 40,000 miles greater than for Europe with 450,000,000 people; and, aside from Europe, is much greater than for the more than 1,000,000,000 people inhabiting all the rest of the world. Our transportational system furnished rapid movement of commodities at a lower rate than that of any other nation.

It is not so many years ago that the American people thought that all of their natural resources would last forever. It was frequently said that the deposits of iron ore, copper and petroleum are inexhaustible. While, before the war, we had developed beyond this simple primitive faith in our bigness, at least so far as scientific men were concerned, we still took it as a matter of course that each year there would be enough of every essential commodity—food, clothing, metals, oil, fuel—to meet without limitation any demands that might be made. While there might be local want in the cities, this was not due to lack of an insufficient quantity of essentials in the country, but to our imperfect economic system. Famine was unknown. From childhood the great majority of our people regarded an abundance of essential commodities as the natural order of our planet; whereas, those who consider the globe as a whole know that a considerable fraction of the people of the world go to bed each night, if not absolutely hungry, at least insufficiently nourished. From time to time, since the dawn of history and doubtless millenniums before, famine has swept over the densely populated portions of the earth carrying away the people by hundreds of thousands or by millions.

Control by Supply and Demand

Under the conditions of abundance in this country, we depended upon the law of supply and demand and competition to control the prices and distribution of commodities. Indeed these doctrines were a faith with both the great political parties, and without being formulated have been unquestioningly accepted by the people for a hundred years.

The Antitrust Laws.—When the period of concentration in industry came with modern transportation, and it become possible by combination and cooperation to control the market and thus unduly enhance prices, a remedy for the trusts was demanded by the people. Congress decided upon prohibition with penalties.

The Sherman antitrust law was enacted, which forbids all combinations and contracts in restraint of trade and monopoly. Similar laws were enacted by the states. Notwithstanding these laws, combination and cooperation continued; and a long series of suits have been brought by the Attorney General of the United States to enforce the Sherman law and dissolve unlawful trusts. But still cooperation existed everywhere, not by definite contracts, but by mutual understanding, so that in any given community the price for each standard commodity was the same. However, the representatives of the people did not surrender their faith that the remedy was to restore the freedom of trade; and in 1915 the Clayton antitrust act was passed, which attempted to bolster up the Sherman act by introducing the new restrictive principle that any combination which resulted in substantial lessening of competition was unlawful.

Thus antecedent to the war, so far as the control of production and distribution of commodities were concerned, we were mainly dependent upon the law of supply and demand with competition and upon repressive laws which should prevent cooperation and allow a free flow of trade.

Regulation Before the War

Regulation, however, had begun. It had become recognized that the public utilities occupied an exceptional position.

The Public Utilities.—All business and industry are so dependent upon transportation, and the public convenience was so interested in having good service without discrimination that, for the railroads and other public utilities, regulation had been adopted as a national policy through the enactment of the Interstate Commerce law and the various state public utilities laws. It is difficult to recall the bitter opposition which the proposal to regulate the public utilities aroused when it was first made. The owners of the stocks and bonds said the railroads were private property, in the control of which the public should have no part. These ideas bring a smile now; but the older men among us remember the fierce contest running through years, before it was established that the public had such an interest in the utilities as to require their regulation.

The Pure Food and Drug Acts.—At another point, it appeared that the laws of supply and demand and competition were not adequate to control commerce. It was the theory of those who held these doctrines in an extreme form that supply and demand and competition would result in securing quality, because poor goods or spurious goods could not compete with good materials. But, after the period of concentration came on, it was found as a matter of fact that food and drugs were extensively sold of inferior quality and even dangerous character under false names. After a prolonged contest, the pure food and drug laws were enacted by Congress and by the several states. The manufacturers of food and drugs denounced these regulatory measures as an interference with private business. It seems odd to us now that any one should consider it a right to sell a food or a drug under a false name. It seems even more strange that the right to sell diseased meats should be regarded as sacred. But this is so recent that probably all here remember the severe struggle to establish the principle that meat should be inspected and found wholesome before being placed upon the market.

During the contest for public control, those who advocated the regulation of the public utilities and foods and drugs were often denounced as socialists and were held up for opprobrium as being in favor of the

subversion of the fundamental principles of our government.

The Administrative Commissions.—As a necessary concomitant of these regulatory movements, commissions or other public agents were created whose duty it was to enforce the public utilities and pure food laws. At first the commissions had small authority; but as necessity arose their powers were expanded. When the present powers of these commissions and agents were worked out, it was found that they were a combination of executive, legislative and judicial; and, thus, instead of keeping these functions separate, they were combined. Regulatory commissions have now become recognized as essential under modern conditions as the executives, legislatures or courts. The development of the administrative commissions is probably the most fundamental change which has taken place in our government since the adoption of the Constitution. Therefore it is not at all surprising that the development of these commissions has been looked upon with suspicion and doubt by the people, in consequence of which it is only slowly and, as proven necessary by irresistible facts, that they have increased in numbers and expanded in functions.

The above is a wholly inadequate, because necessarily all too brief, summary of economic conditions which existed antecedent to the war.

THE EFFECT OF THE WORLD WAR

When the World War broke out in August, 1914, the immediate economic effect was to create almost a panic in this country. The stock exchanges in the chief commercial countries of the world were successively closed. Prices of many commodities fell. But it was not long before the permanent economic effect of the war began to appear.

The Greatly Increased Demand for Commodities

There were withdrawn from productive work by the allies alone 15,000,000 to 20,000,000 of men; and behind the lines as many more were ere long diverted to war manufactories. In consequence of the collosal transfer of the ranks of industry, there was a great decline in the agricultural and ordinary manufacturing production of Europe. Yet, the many millions of men in the field required more than the usual amounts of food and great quantities of clothing. The demand for ships, guns and munitions was insatiable. The result was an extraordinary call for essential commodities from the United States.

Increase in Exports

The amount of wheat which was exported in the fiscal year 1914–15 was more than double that of any previous year. The exportation of meats and fats rapidly increased until it became threefold.

The exports of iron and steel gradually increased until they became fourfold.

The exportation of copper increased twofold. Many other commodities were exported in proportion to those mentioned.

Thus while, from the outbreak of the war, the central powers were in a great measure cut off as export markets for the United States, the needs of the allies were so greatly enhanced as to vastly more than counteract the partial loss of the export market for the central powers.

Increase in Home Demands

Finally in April, 1917, we entered the war; and in consequence there were at once great governmental demands for materials to build ships, for munitions, for food, and for textiles. To meet these needs it was necessary greatly to extend our manufacturing, transportational, mining and

constructional facilities. Thus there arose a greatly increased home call for foods, for textiles, for metals, and for wood. Fundamental to all industry is energy. The energy derived from water can not be readily increased suddenly; and therefore the increased requirements must be met by coal. This particular demand came rather slowly; and it was not until the middle of the summer of 1916 that a shortage of coal appeared probable. From the middle of that year, the demand has exceeded the supply, and exerting every effort, for 1917–18, it is estimated that the supply will be 50,000,000 tons short of the needs, although the production has been largely increased.

Mounting Prices

It thus appears that, in consequence of the World War, we have an absolutely new situation in this country—one in which there is demanded more of every essential commodity than the country is able to supply. Because of this radically changed situation prices began to mount, rather slowly for most commodities until about July, 1915; but since that time for two years rapidly and at an accelerating rate. Prices at about the middle of 1917, as compared with those three years earlier, just before the outbreak of the war, for a number of the most important commodities, were roughly as follows:

Meat animals and meats, 25 to 75 per cent. higher.

Wheat and flour, two and one fourth times as much.

Corn and cornmeal, an increase of 80 per cent.

Potatoes, an increase of about 60 per cent.

Sugar, an increase of 75 per cent.

Cotton and cotton yarns, an increase of 75 per cent.

Wool and worsted, two and one third fold.

Bituminous coal, from two to threefold.

Copper, about two and one half fold.

Pig lead, about threefold.

Pig iron, about three and two thirds times as much.

Steel billets, more than fivefold.

Spelter, nearly double.

Petroleum, an increase of about 75 per cent.

The Causes of Mounting Prices.—The fundamental cause of the mounting prices is that which has already been explained, an unusual and extraordinary demand at first abroad and later at home for all essential commodities; but this has been only one factor in the process.

When it was generally appreciated that there was likely to be a shortage of the essential commodities, the home purchasers, instead of buying ordinary amounts, purchased in advance of their needs. Thus the family, instead of buying flour by the sack, bought a number of barrels; or, in some instances, bought flour for years ahead. The same was true for sugar. Similarly during the spring and summer of 1917, when it was appreciated that there was a shortage in coal, many manufacturers tried to protect their business by accumulating reserves to carry them through the winter. Many of those who required coal for heat did likewise.

The consequence of the unusual buying campaign was that the demands of purchasers were far beyond what would have been necessary to meet actual needs, had the ordinary procedure been followed. This frenzy of excessive buying greatly aggravated the situation.

Another important cause of the rising prices was that a time when there is an extraordinary demand is especially advantageous for speculators to accumulate larger stores of goods of various kinds and hold them for advances in prices. This

was done on a great scale throughout the country for every essential commodity.

Finally, when the conditions are set forth, it is especially easy for those in a given line of business to cooperate to push prices upward and thus greatly increase their profits. This also was done extensively for many commodities.

Based upon the first factor, the second, third and fourth factors have come in to accelerate advancing prices, each with reinforcing power. The tendencies above described, once started, are cumulative, and the enhancement of prices goes on with increasing velocity. The prices of foods are advanced; the employees must have higher pay because of the increased cost of food; the raw materials for manufactured articles are advanced; the manufacturer charges a higher price for his articles because he must pay more for his labor and an increased price for his raw materials. The jobber and the retailer did likewise. At each successive stage the advance of prices is made sufficient to cover the increased cost and an additional increment is placed on top. The cycle thus completed, is begun again with food, and the circle once more gone around. The second cycle completed, the conditions are right for a third cycle, and so on indefinitely, with the result that prices rose beyond all reason, like a spiral ascending to the sky.

Failure of Control by Supply and Demand

Under pre-war conditions, when the supply was equal to and often greater than the demand, the prices, if not adequately controlled, had been largely controlled by competition, except where there had been cooperation of purchasers or manipulators, or both, to control the market; but the facts presented show that under the war conditions the laws of supply and demand and competition adequately to control prices have broken down, for the simple reason that for every staple commodity the demand is ever greater than the supply.

It is not possible to give percentages of the extent to which the demand exceeds the supply for each commodity; but it is safe to say that the percentages upon the average are not large, probably not more than 20 per cent., and for scarcely any commodity more than 30 to 40 per cent. Thus for coal the demand for the current year over that of last year is 20 per cent., and the excess demand for this year over the production not to exceed 10 per cent.

However, the moderate excess demand, taken in connection with buying in advance of needs, of forestalling by speculators, and combination to control the market, has been sufficient to increase the prices of many essential commodities by 100, 200, 300, and even 400 per cent., and for certain articles greater amounts. It is therefore clear that there is no relation whatever between the excess demand and the increase of prices under the competitive system. An increase demand of one tenth or one fifth may increase prices two, four, or even five fold.

There is no reason to suppose that the excess demand will decrease in the near future; indeed it is probable that next year the demand for commodities will be greater than this year; and this situation of excess demand over the possible supply will almost certainly continue to the end of the war and possibly even longer. So long as the excess demand exists, if supply and demand are allowed to have full play, prices will continue to climb.

The situation above described in regard to an inadequate supply of essential commodities and their ever-increasing prices demonstrate that, under the war conditions, the laws of supply and demand and competition are insufficient to secure the neces-

sary increase in production, to control distribution, and to hold prices at proper levels. If the war is to be carried to a successful conclusion the production of the United States must be enormously increased. The distribution of the essential commodities must be such as to meet the various needs in proportion to their importance. The prices to the people of the United States and the Allies must be reasonable else extortion will continue on a vast scale both from ourselves and our associates; but the law of supply and demand and competition did none of these things—even the increase in production was inadequate.

REGULATORY MEASURES NECESSARY

To remedy the situation the President asked Congress for one regulatory measure after another. The crisis was such that these requests have all been met. The result is a most amazing series of regulatory enactments. These are as follows: The food and fuel administration act, the shipping act, the espionage act, the trading with the enemy act, and the priority act. Also the War Industries Board and the Federal Court have instituted regulatory measures without congressional action.

It is my purpose very briefly and inadequately to summarize some of the things which have been done under these regulatory measures and, following such summary, to discuss the principles involved. All of the measures enacted by Congress grant the powers to the President. These he has in some cases at first exercised, but later delegated them to agencies created as authorized by the acts. After such agents have been created, the President has issued proclamations from time to time in accordance with the recommendations of the several agencies. In the succeeding pages, for the sake of brevity, no discrimination is made between the exercise of the powers by the President directly and their exercise by his agents.

The Food Administration Act

Under the Food Administration Act, the President appointed Herbert Hoover, Food Administrator. The latter organized the Food Administration. A licensing system has been introduced for all essential food commodities. Manufacturers, wholesalers, and other distributors are required to take out a license in order to conduct their business. Under the terms of these licenses, hoarding and speculation are to be eliminated and only fair and reasonable profits or charges are to be made for services rendered. Thus the charge which the miller may make for the manufacture of flour and the margin which the jobber may take for its distribution is definitely limited.

The law confines the control of the Food Administration to the zone between the original producers, that is, the farmers and the farmers associations and the retailers with a business less than $100,000 per annum. The manufacturers and the wholesalers are directly reached by regulation; the farmers and retailers only indirectly. While the base price of the producer is not controlled, intermediate additions are, so that the product reaches the retailer with only a fair increment added to the price of the producer. The public is informed in regard to the price which the retailer pays and what would be a fair price which he should charge.

Scarcely less important than the regulation of prices is the control of distribution. The Food Administration decides upon the amount of the essential commodities which go abroad and to what country they are to go. Not only so, but he controls the home distribution, and if advisable, even to the extent of the purposes for

which the commodities are used and the amount.

The situation is well illustrated by the staples—sugar and wheat and its products.

Sugar.—For sugar the Food Administration has made agreements with the producers in regard to the prices which they are to receive; with the refiners concerning the prices they are to charge for their services; has limited the margins of the jobbers and wholesalers; and thus has controlled the price at which the commodity should be sold to the retailer. Also the Food Administration has indicated what would be a fair margin for the retailer. Thus the public knows precisely what it should pay for sugar in any locality. Further, the Food Administration has very sharply controlled the distribution of sugar, deciding absolutely the amount which is to go abroad, and has limited the amount of sugar to be used in certain industries, such as the bakers and the confectioners.

Wheat and Its Products.—For wheat the control has gone even farther. The price of wheat has been fixed for each grade at the primary central markets. To handle wheat a grain corporation has been formed, which organization has actually bought and sold wheat to the extent necessary to reach the required results. While only a small part of the wheat crop has been bought and sold by the grain corporation, the other larger part has been controlled as completely as if it were bought and sold; that is, the grain seller and the miller and exporter have been brought into direct relations. The wheat remains at home or is sent to our associates in war in accordance with the directions of the Food Administration. With few exceptions sales have been carried on at the prices fixed by the Food Administration, and thus the dealing in wheat is practically a government-controlled monopoly.

By limiting the charges of the miller, the price of flour at the mills is as definitely controlled as the price of wheat. The jobbers' margins are fixed and the freight rates are known. The bakers have been brought under licenses, which provide for a standard loaf, both in regard to its constituents and its weight. The price of this standard loaf is therefore definitely determined for the bakers in different parts of the country; and this gives a basis upon which to announce a fair charge by the retailers. This for a pound loaf is from 7 to 9 cents. Thus the price of bread, the staff of life, is brought under control.

In distributing the wheat, its main routes of travel have been very greatly changed. Under pre-war conditions the wheat very largely went to the great central markets and especially Chicago and St. Louis. The price of the wheat of the country was controlled by Chicago quotations; and this market, and to a lesser extent St. Louis, served as magnets which drew the wheat to these centers. From these centers it was redistributed. Under the Food Administration the importance of these centers has diminished; cross and return freights have been avoided. The wheat for export has very largely gone directly south to the Gulf ports and there found an outlet instead of East to the Atlantic ports. The wheat not exported has gone directly to the milling centers, in proportion to their capacity, there to be converted into flour.

Other Foods.—Other essential foods have been placed under the licensing system and thus to a large extent controlled, although as yet regulation has not gone to the extent of that for wheat and its products and sugar, but the Food Administration is moving from one essential commodity to another. Thus the first step in the control of the price of meat—the limitation

of the profits of the packers—has been taken.

As a result of the work of the Food Administration the skyward movement of prices has been checked, and for some of the most essential commodities such as wheat, the product of wheat flour, and bread, there have been actual reductions in price. Also prices have been stabilized. Dealing in futures for the most essential products has been prohibited and hoarding and speculation prevented.

The Fuel Administration Law

One section of the Food Administration act authorized the control of fuel. Under this section the President appointed H. A. Garfield Fuel Administrator. The maximum price of each kind of coal and coke at its source has been fixed. Moreover, the margins which are allowed to the jobbers and to the retailers have been limited, and thus the price of coal to the consumer has been controlled. Therefore for coal, the price control occupies the full field rather than the zone between the producer and the retailer as in the case of wheat.

The Fuel Administration has also controlled wage contracts with the miners. When a considerable advance of wages was approved, it was made a part of the contract that the miners should be penalized $1 a day if they declined to work or ceased to work during the time the contracts into which they had entered remained in force.

The distribution of coal and coke has been controlled as completely as the price. The coal has gone for the purposes and to the various districts in accordance with the decisions of the Fuel Administration. The amount of coal which goes abroad is also controlled. Thus the amount assigned to Canada is the quantity received last year plus the same percentage of increase as that obtained by the United States.

The prices have not been fixed exclusively upon the basis of the heating power and the location of the coal, but in part upon the basis of the cost of production. In many instances this gives the poorer mine which is unfavorably located a higher price per thermal unit than the rich mine favorably located. This practise is in complete contravention to economic theories accepted before the war. The owner of a better property gained all the advantages of cheapness of operation and convenience of transportation.

Had the Fuel Administration so decided, it would have been possible under the law for the government to become the exclusive buyer and seller of the coal for the country. Had this method been used, the coal mined would have been sold to the Fuel Administrator by the operator at a fair profit. The coal then his property would have been pooled and sold at prices dependent upon its value, taking into account its thermal power and other qualities and its position in the country in regard to freight. The prices fixed would have been sufficient to cover its cost, including that of administration.

The Shipping Board and Emergency Fleet Corporation Boards

The United States Shipping Board has requisitioned all cargo ships and tankers registered under the laws of the United States of not less than 2,500 tons total dead weight capacity, and all passenger steamers of not less than 2,500 tons gross register. These vessels, thus requisitioned, have in general been leased to the companies which before have been operating them, the companies receiving a definite compensation based, for freight boats, upon dead weight ton capacity, and for passenger vessels upon the number of passengers which they can carry. The vesesls are to sail on routes and

carry goods as determined by the Shipping Board.

The Shipping Board also exercises the control of interstate commerce by water, its powers being analogous for water transportation to those which have been exercised by the Interstate Commerce Commission in regard to railroads. However, the powers of the Shipping Board extend beyond those of the Interstate Commerce Commission in that the board is allowed to approve any agreement between common carriers by water concerning rates, accommodations, pooling, limited sailings, and other arrangements; and all agreements thus approved by the board are exempt from the Sherman antitrust law and its amendments.

Under the Shipping Board, there has been organized the Emergency Fleet Corporation with a capital stock of $50,000,000. This corporation has requisitioned all the shipyards of the United States and all the ships under construction. The ships will be completed in accordance with the directions of the Fleet Corporation. The actual operation of the yards and the finishing of the ships remain with the corporations and persons who previously had them in charge, but the compensation which they are to receive is upon the basis of a fair profit, which is decided by the Fleet Corporation.

The Fleet Corporation is also engaged on a gigantic scale in the construction of additional ship-building plants and in the construction of new ships. This work is largely done not by the Fleet Corporation itself, but under contract. The Emergency Fleet Corporation has announced that the actual building program under contract embraces more than 8,000,000 tons, dead weight capacity.

Charles R. Van Hise

University of Wisconsin

(*To be continued*)

THE NOMENCLATURE USED IN COLLOID CHEMISTRY. A PLEA FOR REFORM

Colloid chemistry is no longer considered as a mere collection of mysterious substances and "abnormal" reactions. It is an important branch of chemical and physical science possessing a fairly well established working basis and is rapidly acquiring new students.

It suffers, however, like all virgin sciences, the affliction of superfluity of terms used to describe essentially the same things, careless and loose use of some expressions, and confusion of nomenclature in general. This condition results in a great handicap to new students. It is very difficult for them to acquire clear conceptions from their first readings of the various works on the subject.

It is time that this matter be taken in hand by some committee of our Chemical Society for the purpose of removing this needless handicap and confusion by defining the various terms used in colloid science, eliminating unnecessary ones and by standardization of the terminology in general, just as was done with the terminology of the proteins by the biological chemists some years ago.

The paragraphs which follow attempt to point out some of the cases of malusage of terms.

No objection can be raised against the word "colloid." It is distinctive, but the use of the expression "colloidal *solution*" is to be strongly condemned, since it is so evident that substances in the colloidal condition are not dissolved, in the strict sense of the term. Colloidal particles are in a condition midway between solution and mechanical suspension, and they are held in this peculiar state of *dispersion* by virtue of their surface energy, electrical charge, their kinetic energy as manifested by the Brownian movement, and the adsorbed ions of electrolytes which are essential to the stability of all colloids.

The general term "dispersion," as suggested by Wo. Ostwald, is to be preferred to the special term "solution." *E.g.*,

"Mechanical suspensions" are	Coarse dispersions,

"Colloidal solutions"
are Colloidal dispersions,
and
"True solutions" are Molecular dispersions.

The particles, or "internal phase" of these systems are known as the "dispersed phase," and the liquid in which they are dispersed, the external phase, is known as the "dispersion medium."

The present usage of the word "sol" and of its modifications—"hydrosol," "alcosol," etc., to describe a colloidal dispersion, is the same as that of Graham, their originator. I have noticed, however, that the word "sol" has been used by a few writers in the sense of the dispersed phase, *i. e.*, the particles in colloidal dispersion. Is this use of the term to be permitted? Graham invented it as a short and convenient substitute for colloidal "solution" and a perusal of the works by Bechhold, Cassuto, Freundlich, Hatchek, Ostwald, Taylor and Zsigmondy shows that the original sense of the expression has been retained by these writers.

The use of the term "gel," however, and of its modifications, "hydrogel," "alcogel," etc., is deplorably loose and confusing. This term was coined by Graham[1] and first used by him in discussing the "pectization" or coagulation of the hydrosol of silicic acid. Therefore, if we are to limit the use of "gel" to its original sense, we should use it only when speaking of the definite *coagula* of sols. This is not the case, however. Any substance which resembles a jelly in appearance is called "gel," although in chemical and physical properties it may be entirely different from the kind of matter which Graham had in mind when he invented the term. This use of the expression is exceedingly popular and would be very difficult to overcome.

Let us take up a case or two to show how unscientific this latter usage of the term is. For example, consider the dissolution or dispersion of gelatine in hot water. It forms a very mobile "solution" or rather dispersion, and in this form is called a hydrosol or sol. If this hydrosol be allowed to cool, it becomes very viscous and "sets" to a jelly-like mass. In this stiffened form it is popularly known as a "hydrogel" or "gel." If it be warmed again, its viscosity decreases, it becomes mobile and is called a "sol." Now if this use of the term "gel" (which is not as Graham intended) is to be permitted, then what is the line of demarcation between the sol and gel states? A change in state has occurred, it is true, for in the sol condition the water was the external phase whereas in the so-called gel state the gelatine became the external phase and the water internal. The change is very gradual, however, and our change of terms to suit the change in appearance of the system is exceedingly arbitrary and unscientific. Furthermore no chemical change in the nature of the gelatine has taken place.

If some alum or a trace of mercuric chloride be added to the gelatine hydrosol, a coagulum is obtained which is correctly termed a gel according to Graham. This is a coagulated compound, however, a chemical reaction has taken place. It will not redissolve in water and is, therefore, entirely different from the case discussed above, which is also commonly called gel.

To further complicate matters, the dry pieces of gelatine (and in fact any other colloid which will "dissolve" readily) which were used to make the original sol are also quite commonly called "gel." Lottermoser called attention to this several years ago and suggested that such pieces of gelatine, or of any other dry "soluble" colloid be called "solid sol." This suggestion is obviously bad. Why apply any special term at all?

When a hydrous ferric oxide sol is allowed to evaporate spontaneously, it will go through a jelly-like stage and finally become a hard scaly residue when all or nearly all of the water has left it. The jelly-like form will redisperse when warmed with an excess of water, while the amorphous form will not. Yet both forms are called "gel"! Zsigmondy distingishes between these two different forms by calling the first one "hydrogel" and the second, "gel."

[1] *Proc. Roy. Soc.*, 13, 337 (1864).

A review of the texts on colloidal chemistry shows the following conceptions of this term.

Cassuto[2] calls a gel the gelatinous precipitate obtained from a sol by means of an electrolyte, heat or evaporation. *I. e.*, a gel is formed by coagulation of a sol. He calls stiffened sols (or jellies), "gelatines."

Bechhold[3] remarks the loose use of the word "gel" and states that he restricts it to the description of the coagula from sols. To the stiffened sols or jellies he applies the term "Gallerte," which in English might be called "jelly."

Freundlich[4] says that systems of solid dispersion media and liquid dispersed phase are gels as distinguished from the reverse which are suspensions or emulsions. In other words he applies the word "gel" to jellies.

Hatschek[5] refers to the fact that Graham applied the name "gels" to the products obtained by the coagulation of sols, but later on in his book he calls jellies, gels also.

Ostwald in his "Handbook of Colloid Chemistry," considers all colloids as gels when the system becomes "microscopically heterogeneous." That is to say, he applies the term promiscuously.

Taylor[6] uses "gel" in the same loose general manner as Ostwald, Hatschek and Freundlich.

Zsigmondy in his "Kolloidchemie," limits the word "gel" to the dry residue which will not redisperse in a solvent, but he applies "hydrogel" to the jelly-like mass formed by removal of the dispersion medium or by salt coagulation.

Hardy[7] recognized the difference in properties of substances called "gels" and he qualified the term—"gels by coagulation" and "gels by stiffening."

I feel confident that Graham did not apply this term as loosely as is popular at the present time. In his remarks on the properties of colloidal tungstic acid[8] he says: "It is remarkable that the purified acid is not pectized by acids or salts even at the boiling temperature. Evaporated to dryness, it forms vitreous scales, like gum or gelatine." Note that he describes the dry residue as "scales, like gum or gelatine" and not as gel.

It is evident, then, that the original meaning of the term gel has not been adhered to and in fact is more often applied to the state best described as jellies. Shall we adhere to Graham's definition or shall we discard it, restricting the term gel and its modifications to jellies, as popularity favors, and do away with any special terms to describe coagula from sols by electrolytes, or residues formed by evaporation to dryness? Special terms to describe these last two cases are obviously unnecessary and serve only to encumber colloid chemistry.

Lately the word "peptization" or "peptinization," as originated by Graham, has shown tendencies of wider use than formerly. Graham used this expression to describe the formation of a sol from a gel by the influence of a small amount of foreign reagent as, for example, the formation of a hydrous ferric oxide sol from a coagulum of ferric hydroxide by treatment with a small amount of hydrochloric acid or ferric chloride. He named it "peptization" because it resembled the hydrolysis of egg white to peptone by acid.

Cassuto, Hatschek, von Weimarn and Zsigmondy preserve the original sense of this term. Bancroft[9] has recently proposed, however, that we use peptization to describe all cases of transformation of gel (using this term in the present popular sense) to sol and not restrict it merely to cases where a foreign electrolyte has been added to accomplish the change. *E. g.*, when dry gelatine is "dissolved" in water Bancroft would call it a case of gelatine being peptized by water. This usage has its merits because it eliminates the word "dissolve" and the implication of "solution."

[2] "Die Kolloide Zustand der Materie."

[3] "Kolloide in Biologie und Medizin."

[4] "Kapillarchemie."

[5] "Introduction to the Physics and Chemistry of Colloids."

[6] "Chemistry of Colloids."

[7] *Z. physik. Chem.*, 33, 326; 385 (1900).

[8] *L. c.*, p. 340.

[9] *J. Phys. Chem.*, 20, 85–117 (1916).

Ostwald defines peptization as the phenomenon opposed to coagulation.

Taylor prefers a new term, "solation," which he applies to all cases of gel $\rightarrow$ sol transformations, and incidentally he urges the adoption of "gelation" to define all cases of sol $\rightarrow$ gel transformations instead of coagulation or pectization.

"Pectization," another of Graham's terms, is rapidly dying out. The word "coagulation" covers all cases of pectization and therefore why preserve an unnecessary term? Furthermore, why adopt the new term "gelation" proposed by Taylor. "Coagulation" is adequate. Of course, if it is decided to name jellies (stiffened sols) "gels," then the word "gelation" would be a good one to describe the "setting" of the gel or the stiffening of the sol.

Elimination of some synonymous terms is decidedly necessary from the list of names applied to the two more or less distinct classes or systems of colloid dispersions. For example, these two systems are variously named as follows:

Authors		
Noyes[10]	Colloidal solutions	Colloidal suspensions
Hardy,[11] Zsigmondy[12]	Reversible colloids	Irreversible colloids
Billitzer[13]	Baser colloids	Typical or genuine colloids
?	Hydrophilous colloids	Anhydrophilous colloids
Henri[14]	Stable colloids	Unstable colloids
Perrin, Freundlich,[15] Neumann[16]	Lyophilic colloids	Lyophobic colloids
Bary[17]	Dissolving colloids	Electrical colloids
Wo. Ostwald[18]	Emulsion colloids	Suspension colloids
von Weimarn[19]	Emulsoids	Suspensoids
Burton[20]	Gelatinizing type	Non-gelatinizing type

The terms "emulsoid" and "suspensoid" are very popular. "Lyophilic" and "lyophobic" are very expressive. The "stable-unstable" and the "reversible-irreversible" terms should be abolished, since they describe the conduct and changes in state of colloids when subjected to external conditions and are not always sharply defined. For example, hydrous ferric oxide sol is fairly stable in the presence of neutral electrolyte (much more so than colloidal gold or platinum), while it is irreversible when evaporated to *dryness*. Most writers classify it with the suspensoids, although Taylor calls it an emulsoid (since if it be evaporated *not quite* to dryness it is partially reversible). In reality it belongs to neither of these two generally accepted classes; its properties place it midway between the two, nearer the suspensoid than the emulsoid class. All the hydrous oxides of the basic or acidic elements act similar to hydrous ferric oxide.

On account of this confusion of classification Bancroft[21] has suggested that the distinction between these two groups be done away with. He prefers to classify colloidal systems according as to whether water or the more mobile phase, is the internal or the external phase and states: "While we are reasonably sure that colloidal gold is a solid and that colloidal oil is a liquid, the two behave exactly alike when both are suspended electrically."

This suggestion is along the proper lines, but is too sweeping, since colloidal gold and colloidal oil do not behave alike.

After a consideration of all the terms, it would seem that "lyophilic" and "lyophobic," or their more special derivatives, "hydrophobic" are the least objectionable terms, since most colloids answer to one of these designations. When our knowledge of colloids becomes exact enough to *sharply* differ-

[10] *J. Am. Chem. Soc.*, 27, 85 (1905).

[11] *Proc. Roy. Soc.*, 66, 95 (1900).

[12] "Kolloidchemie."

[13] *Z. physik. Chem.*, 45, 307 (1903).

[14] *Z. physik. Chem.*, 51, 29 (1905).

[15] "Kapillarchemie."

[16] *Koll. Z.*, 3, 80 (1908).

[17] *J. Chim. Phys.*, 10, 437 (1912).

[18] "Handbook of Colloid Chemistry."

[19] "Grundzüge der Dispersoidchemie."

[20] "Physical Properties of Colloidal Solutions."

[21] *J. Phys. Chem.*, 18, 549–558 (1914).

entiate between these two classes then we may find names for those systems which now seem to have properties which place them in neither of the above.

Before concluding, attention is directed to the irritating, although not very serious, mistake in the translations of the German terms "disperse" and "dispersions Mittel" by some authors. The German adjective "disperse" is "dispersed" in English, not "disperse," and "disperse Phase" is "dispersed phase," while "dispersions Mittel" is "dispersion medium" and not "dispersion means." These mistakes are like the old one of translating "Wanderung der Ionen" "wandering of the ions" instead of "migration of ions."

Arthur W. Thomas
Department of Chemistry,
Columbia University

ADDRESS AT THE FUNERAL SERVICES OF JOSEPH YOUNG BERGEN

I have known Mr. Bergen for nearly thirty years, and for a considerable time I was intimately associated with him in the authorship of a book, a text-book of physics. He did not begin his scientific work as a physicist; he began it as a chemist, and he did not end it as a physicist; he ended it as a botanist. But these changes in the subject of his labors, like the changes in his place of residence—from the middle west to New England, then to Italy, then back to New England—came from no fickleness of interest or infirmity of purpose. They were the result of certain hard conditions working on a man of extraordinary versatility, of extraordinary capacity, of extraordinary devotion to high ideals.

As a teacher he was not content merely to hold a place; he was receptive, active-minded, original; his alertness of observation, his catholicity of interest, his energy of imagination, enabled him to take the dry, dull matters of daily experience and kindle them into a source of illumination and vivifying power. As a writer of books he was not satisfied to give the public of his readers merely what it wanted. In physics and later in botany he took a large part in a great revolutionary movement affecting the teaching of science in all the secondary schools of this country, so that his name became familiar to all the progressive teachers of physics or teachers of botany throughout the land. And in those other writings, of a less formal character, in which he and Mrs. Bergen cooperated with perfect sympathy, there was a solidity of substance and a quality of form that commanded, I believe, the respect and the approval of profound scholars.

Nor was this all. What a fine, brave thing it was for a man of middle life, with an assured position as a teacher and with little financial assurance elsewhere, to give up this position and go to Italy, in order to pursue his scientific studies in their higher aspect, the aspect of original research, and to give his wife the physical conditions of life which she needed and for which she longed. And how finely, how bravely, he bore the care, the anxiety, the sorrow, that come to all of us in some measure and that came to him, it might seem, almost beyond measure.

With this character and this career, what manner of man did he seem to those who met and talked with him? I remember him vividly as I used to see him twenty-five years ago, the tall, spare, slightly bending figure, the long, swift, gliding stride, the abundant tawny hair and beard, the great brow jutting over the resolute, patient, illuminated face. And what was his manner of conversation? He talked freely and of many things, but not in commonplaces. It was not that he avoided commonplaces; they did not occur to him; he had not a commonplace mind. If one was in the mood to indulge in the ordinary gossip of the day, one was not in condition to sustain worthily a conversation with him.

But on one matter, one great matter, he never, so far as I can now recall, spoke to me. He was the son of a minister, and he once described to me with a certain grimness of humor some of the trials of a minister's family; but of religion, of religious faith or creed, he did not speak. He may have had a feeling, since I was a constant church-goer

and he was the contrary, that we should not be sufficiently in sympathy to discuss these matters with good feeling. I do not know how this may have been; but, speaking as one who, though subscribing to no formal religious creed, has a religious faith which is precious and a religious experience that is vital, I can not easily believe that our friend had nothing of these possessions. For the best evidence of something divine within ourselves and of something divine greater than our individual selves comes to us through affliction and sorrow borne with love; and this experience he had in full.

EDWIN H. HALL

HARVARD UNIVERSITY

SCIENTIFIC EVENTS

THE MEDALLISTS OF THE ROYAL SOCIETY

AT the anniversary meeting of the Royal Society on November 30, the president, Sir J. J. Thomson, conferred the medals of the society. The work of the recipients was thus characterized:

Copley Medal.—M. Emile Roux, Pasteur's chief collaborator, succeeded him as the director of the Institut Pasteur, which he has successfully developed and maintained as the foremost school of bacteriology, both for teaching and for research. From the early eighties, when he was associated with Pasteur and Chamberland in the study of anthrax and the production of vaccines against this disease, he has played a leading part in the development of our knowledge of the processes of immunity. His work with the distinguished veterinarian Nocard upon the contagious pleuro-pneumonia of cattle was the first demonstration of the existence of "ultra-microscopic," or, as they are now termed, filterable viruses as disease-producing agencies; his work with Yersin, the first full study of the bacillus of diphtheria and of its toxins. He shares with the late Professor Behring, of Marburg, in the introduction of diphtheria antitoxin as a practical means of prophylaxis and cure, and with him as cofounder of serum therapeutics was awarded the Nobel prize. All the leading French bacteriologists of our generation have been his pupils.

Royal Medals.—Dr. Aiken is distinguished for his lifelong researches on the nuclei of cloudy condensation, embodied in a series of memoirs communicated to the Royal Society of Edinburgh. The latest of these appeared in the present year. Dr. Aitken's discoveries opened up a new field of investigation in physics, and constitute a chapter of knowledge of great importance intrinsically and in their relation to the physics of meteorology. Dr. Aitken, who has pursued his work as an amateur, has displayed great experimental ingenuity, and his remarkable construction of the "dust-counter" has provided a permanent scientific appurtenance of precision to the physicist and climatologist. Among other contributions to science, Dr. Aitken has made important advances in our knowledge of the formation of dew.

Dr. Smith Woodward has been for many years keeper of the department of geology in the British Museum, and has published a very large number of valuable memoirs on fossil vertebrates, especially fishes. He has also published an important "Catalogue of Fossil Fishes in the British Museum," and his "Outlines of Vertebrate Paleontology," published in 1898, is a standard text-book on the subject. Dr. Smith Woodward's original memoirs are too numerous to mention, but they have secured for him a world-wide reputation, and he is universally regarded as one of the highest authorities on vertebrate paleontology.

Davy Medal.—M. Albin Haller, professor of organic chemistry at the Sorbonne, Paris, founder and first president of the International Association of Chemical Societies, and at the present time the most representative chemist of France, is distinguished for his many and important contributions to chemical science during the past forty years. His investigations have covered a very wide field in the domain of organic chemistry, the most important being those dealing with compounds belonging to the camphor group. He has maintained over a long period of years the reputation of the Sorbonne School of Chemical Research, created by Dumas and Wurtz, his predecessors in the chair.

Buchanan Medal.—Sir Almroth Edward Wright was the first (1896) to apply laboratory knowledge on typhoid immunity to the protection of human beings against enteric fever. Against formidable opposition he carried out a long series of observations with the highest scientific acumen and unsurpassed technique, and laid the foundations for the effective elimination of enteric fever from the armies of the world. Nothing of importance has been added to his work down to the present time.

Hughes Medal.—Professor C. G. Barkla's investigations have mainly dealt with X-rays, and

their absorption and secondary emission by solid substances. He showed that secondary emission of X-rays was of two varieties. In one of these the X-rays are scattered, without change of quality. The scattered rays were shown by examining tertiary emission to be polarized, and this was a fundamental result for the classification of X-rays with ordinary radiation, at that time doubtful. Professor Barkla's other kind of secondary emission is characteristic of the secondary radiator, and is accompanied by selective absorption of the primary rays. He showed that each chemical element emitted more than one definite kind of secondary fluorescent radiation. Concentrating attention on, say, the less penetrating kind, it was found to vary in quality by definite steps with the atomic weight of the secondary radiator.

REPORT OF THE YEAR'S WORK AT THE U. S. NAVAL OBSERVATORY

In his annual report to the Bureau of Navigation, Rear Admiral Howard, United States Navy, retired, superintendent of the Naval Observatory, says in part:

The time signals were sent out twice daily during the year, at noon and 10 P.M., seventy-fifth meridian time, both by land lines and by radio, through the operating relay at Radio, Va. The improvements mentioned in the last annual report have been completed and put in operation. The accuracy of the radio time signals, which can be picked up anywhere in the north Atlantic, has made it possible to reduce to one the allowance of chronometers for vessels of the Navy operating along the Atlantic coast.

The Naval Observatory has continued the policy of encouraging suggestions and developments of methods and instruments for navigation, particularly for submarines and aircraft.

The nautical-instrument repair shop has continued to prove economical in time and expense as compared with the previous system of having this work done by contract.

Owing to the great increase in ships of the Navy and the lack of receipt of materials and nautical instruments from abroad and the shortage of skilled labor in this country, especially in the manufacture of instruments and chronometers, the question of supply of instruments for navigation, especially chronometers, is becoming a matter of very serious proportions. The increased demand for the gyro-compass and the instruments attached to it is taxing the capacity of the only factory in this country which is able to manufacture this instrument.

Congress did not provide any addition to the clerical force, and it is earnestly recommended that the additional clerks which will be requested in the estimates to be submitted by the superintendent for the next fiscal year be approved and Congress urged to allow the same.

The scientific personnel has met twice each month, except during the summer, for the discussion of current astronomical topics and reading of papers by its members and scientists.

The astronomical work of this institution is now even more important than usual, owing to the European observatories losing many skilled observers due to the war.

Under the head of Aviation instruments and equipment, the report says:

As noted in the last annual report, the year started without any instruments or equipment for aviation, under the cognizance of the Bureau of Navigation, having been standardized.

Sets of clothing as used in the British and French aviation services were inspected at the observatory and at the aeronautic station at Pensacola, as well as sets manufactured by American firms. A board was appointed at Pensacola to specify a standard equipment and their report has been approved. The Bureau of Supplies and Accounts now has specifications for standard articles of clothing and personal equipment.

THE ENLISTMENT IN ENGINEER RESERVE CORPS OF TECHNICAL STUDENTS PENDING COMPLETION OF STUDIES

With the approval of the Secretary of War, Major General W. M. Black, chief of engineers, has promulgated regulations governing the creation of an Engineer Enlisted Reserve Corps, in which may be enrolled, pending completion of their studies, students of recognized technical schools. The announcement reads:

Under such regulations as the Chief of Engineers may prescribe a proportion of the students, as named by the school faculty, pursuing an engineering course in one of the approved technical engineering schools listed in the War Department, may enlist in the Enlisted Reserve Corps of the Engineer Department, and thereafter, upon presentation by the registrant to his local board of a certificate of enlistment, such certificate shall be filed with the questionnaire and the registrant shall be

placed in class V on the ground that he is in the military service of the United States.

In accordance with the authority given by this modification the following regulations are promulgated governing the enlistment by engineer students in the Engineer Enlisted Reserve Corps.

In order to be eligible for enlistment in the Engineer branch of the Enlisted Reserve Corps, under the above-quoted amendment to Selective Service Regulations, a candidate must fulfill the following conditions:

(*a*) He must be a citizen of the United States.

(*b*) He must be a student in one of the schools, the names of which are borne upon the list of technical schools approved by the Secretary of War for the purpose of carrying out section 5 of the river and harbor act approved February 27, 1911, relating to appointments from civil life to the grade of second lieutenant in the Corps of Engineers.

(*c*) He must be regularly enrolled and must be pursuing a course required for the degree of chemical engineer, civil engineer, electrical engineer, mechanical engineer, mining engineer, or some other equivalent engineering or technical degree.

(*d*) He must have made since his entry upon this course at the school a record of standing which will indicate clearly that he may be regarded fairly as deserving a place among the first third, based primarily on the scholastic records, of the young men who have graduated from that institution during the past ten years.

There follow forms of affidavits which are to be signed by the student and the president or dean of the school at which he is studying. The regulations continue:

In order to receive prompt consideration, applications from candidates now at college, and who are over twenty-one years of age, should be submitted so as to reach the office of the Chief of Engineers in Washington not later than January 15. The application from a person who has not reached this age at the present time must be submitted within three months before or one month after he reaches the age of twenty-one.

As rapidly as possible after the receipt of the applications in the Office of the Chief Engineers, they will be carefully examined, and the candidates whose applications are approved will promptly be sent cards of authorization, authorizing them to be enlisted in the Engineer Enlisted Reserve Corps by an office authorized to make enlistments in the Army, provided, of course, that they pass the necessary physical examination which will be made under the direction of the enlisting officer immediately prior to enlistment.

When thus enlisted the student's name will be placed on the "inactive list" of the Engineer Enlisted Reserve Corps, and he will be allowed to remain on this inactive list in order to enable him to complete his course at the institution.

Immediately after the completion of this course, or upon his discontinuance of the course for other reasons, the student will be given the option of being called into active service under his enlistment and being assigned to some one of the engineering branches of the Army, or of being immediately discharged and taking his place again among those subject to service under the draft.

SCIENTIFIC NOTES AND NEWS

THE War Department has established a Chemical Service Section and two lieutenant-colonels have been commissioned, Dr. Raymond F. Bacon, director of the Mellon Institute, Pittsburgh, to have charge of the chemical work in France, and Professor William H. Walker, of the Massachusetts Institute of Technology, to have charge of the work in the United States.

THE Perkin Medal Committee, consisting of members of the various chemical societies, has awarded the Perkin Medal for 1918 to Auguste J. Rossi of Niagara Falls, New York, in recognition of his work on titanium. The Perkin Medal was founded in 1906 by the New York Section of the Society of Chemical Industry to commemorate Sir William Perkin.

PROFESSOR A. RIGHI, professor of physics at Bologne, has been elected an honorary member of the British Institution of Electrical Engineers.

PROFESSOR T. B. WOOD, Drapers professor of agriculture in the University of Cambridge, has been appointed a member of the British Development Commission in succession to Mr. A. D. Hall, now secretary to the Board of Agriculture.

DR. ARTHUR KEITH, F.R.S., conservator of the Museum of the Royal College of Surgeons, has been appointed Fullerian professor of physiology in the Royal Institution.

Professor S. C. Prescott, of the department of biology and public health of the Massachusetts Institute of Technology, has been appointed to a commission as major in the food division of the Army Sanitary Corps.

Professor Charles P. Berkey, of Columbia University, as chairman of the committee on highways for the state of New York, has transmitted to the National Research Council a report on road materials and conditions controlling the construction of highways and other roads in New York.

Victor Yngve has been engaged as research chemist by the Oldbury Electro Chemical Company of Niagara Falls, N. Y., and will have charge of their research laboratory.

For the New Mexico Association for Science, officers for 1918 have been chosen as follows: *President*, Dr. John D. Clark, of the University of New Mexico; *vice-president*, J. E. Brownlee of the Normal School; *secretary*, Professor Higley of the Agricultural College; *treasurer*, Professor Goddard of the Agricultural College; members of the Educational Council, Paul A. F. Walter, for three years, Professor Rodgers of the Normal University for two years and Professor Barnes of the Agricultural College for one year.

Professor J. F. Adams, of Pennsylvania State College, is on leave of absence for a year and is spending the time at Columbia University and at the New York Botanical Garden. He is making a detailed study of a group of microscopic fungi, many of which occur as parasites on living plants.

Vilhjalmur Stefanssen, the Arctic explorer, last heard from in a letter received in March, 1916, has arrived with his party at Fort Yukon, according to word received by the naval department. Stefanssen, head of the Canadian Arctic Expedition has been in the far North since 1913 and lately there was some anxiety as to his safety.

Professor Wilder D. Bancroft, of Cornell University, lectured before the District of Columbia Chapter of the Sigma Xi on December 20, on Colloid Chemistry.

Professor R. D. Salisbury of the University of Chicago spoke on "Geography and geology work about Camp Grant," the National Army cantonment at Rockford in northern Illinois, at the Post-Vacation Luncheon of the Geographic Society at Chicago, on November 17.

At the request of the Medical Research Committee of Great Britain, Professor W. M. Bayliss last August visited various centers in France, to discuss with workers there special problems in the field and the application to them of methods devised in the laboratory. Acting upon suggestions made to it from France the committee appointed a special investigation committee for the purposes of further combined study of shock and the better correlation of laboratory and clinical observations. This committee consists of Professor F. A. Bainbridge, Professor W. M. Bayliss, F.R.S., Professor W. B. Cannon, Dr. H. H. Dale, F.R.S. (secretary), Lieutenant-Colonel T. R. Elliott, F.R.S., Captain John Fraser, Professor C. S. Sherrington, F.R.S., Professor E. H. Starling, F.R.S. (chairman), and Colonel Cuthbert Wallace, C.B. Professor W. B. Cannon, of Harvard University, whose work in this connection is of great value, is making arrangements for coordinating the work of this committee with that of a similar committee of American physiologists, and a further memorandum on the subject will probably be issued.

The Romanes lectures at the University of Oxford, which were not given in 1917, will next year be given by Mr. Asquith, lately premier, who is honorary fellow of Balliol College.

Portraits of the late Professor Raphael Meldola, painted by Mr. S. J. Solomon, were in December 18 presented to the Royal Society and to the Institute of Chemistry of Great Britain and Ireland.

Dr. Theodore Caldwell Janeway, since 1914 professor of medicine at the Johns Hopkins University and previously Bard professor of medicine at Columbia University, died on December 26 at his home in Baltimore

of pneumonia. Since the United States entered the war Dr. Janeway had been engaged in special research work for the government, being major in the Medical Officers' Reserve, on duty in Washington.

DR. HUGO SCHWEITZER, the industrial chemist, head of the Synthetic Patents Co., died on December 23 at his home in New York after a short illness from pneumonia. He was born in Germany in 1861 and came to this country in 1889.

PROFESSOR CLEMENT HENRY MCLEOD, professor of astronomy, surveying and geodesy, McGill University, in charge of the observatory, died on December 26, aged sixty-six years.

CHARLES HAWKSLEY, past president of the British Institution of Civil Engineers, died on November 27, aged eighty-seven years.

DR. A. M. W. DOWNING, formerly superintendent of the *Nautical Almanac*, died suddenly on December 8, at sixty-seven years of age.

DR. FRITZ DANIEL FRECH, professor of geology and paleontology in the University of Breslau, has died at the age of fifty-six years.

M. JOYEUX LAFFNIE, professor of zoology in the University of Caen, has died at the age of sixty-five years.

SURGEON GENERAL RUPERT BLUE, of the United States Public Health Service, has asked Congress to appropriate $300,000 for the purpose of establishing a Sanitary Reserve Corps, to combat outbreaks of disease in both times of war and times of peace. He also asked for appropriations to purchase quarantine stations at New York and Baltimore.

MR. HARRY PIERS, curator of the Provincial Museum at Halifax, has replied to an inquiry from Mr. Harlan I. Smith, regarding the relation of the explosion to the museum. The specimens and labels apparently came through fairly well, better than was expected, considering the unbelievably terrific and astonishingly loud explosion which demolished the Richmond section of Halifax, although windows were blown in, glass of cases smashed, a water pipe burst and snow stormed into one end of the building. Mr. Piers calls attention to the good results of always using water-proof ink for labels. The cases were boarded over soon after the explosion in order to use them as tables for Red Cross and other relief supplies, so that a careful examination of the damage has not been made. The publications probably have not suffered greatly. At the time of writing Mr. Piers had been too busy on relief work to examine into details of the museum.

MR. T. F. CLAXTON, director of the Royal Observatory, Hong-Kong, informs *Nature* that, in view of the world situation, it has been decided to discontinue sending the publications of the observatory to the United Kingdom, Europe and India during the war.

WE learn from *Nature* that a Linnean Society has been established recently in Sweden as "Svenska Linné-Sällskapet," intended as a means for spreading information about Sweden's greatest naturalist, Carl von Linné (1707–78). The society purposes to do this by publication of works by Linné and his pupils; to throw new light from modern viewpoints on Linné's personality; to draw up a catalogue of all known memorials, and to found a complete Linnean library. The president is Dr. Tycho Tullberg, a lineal descendant of Linné.

ACCORDING to the annual report of the chief of the Weather Bureau to the United States Secretary of Agriculture, a manual or handbook entitled "Meteorology and Aeronautics" will appear as Report No. 13 of the National Advisory Committee for Aeronautics. The handbook discusses the properties and general phenomena of the atmosphere which aeronauts and aviators should understand. It is divided into three parts: Part one, which deals with physical properties and dynamics of the atmosphere; part two, with topographic and climatic factors in relation to aeronautics, and part three, with current meteorology and its use. Part three also contains a summary of the free air conditions most likely to be experienced under different types of pressure distribution at the earth's surface. Frequent conferences have been held with officials of the

aeronautical branches of the Army and Navy, and plans are being perfected at several of the training camps for free-air observations in aid of aeronautics and the firing of projectiles. Copies may be obtained on application to the National Advisory Committee for Aeronautics, Washington, D. C.

Practically inexhaustible deposits of manganese dioxide, which is extremely valuable as an iron-toughening material and in great demand for war munition purposes, have been found in the Cypress Hill in South-East Albert, Canada. Eight hundred thousand tons, worth approximately £11,000,000, have been blocked out by ordinary post-hole augers in the last few months. The announcement is also made that the staff of the department of mining of the University of Toronto have discovered a process by which low-grade concentrates of molybdenite can be made at little cost. Molybdenite is used for hardening and toughening steel, and it is most useful in the manufacture of high-speed tools. Quebec is a larger producer, but the need for molybdenite is great, and the new process will, it is stated, render available the deposits of low-grade molybdenum ore which have been discovered in Manitoba and British Columbia.

It is stated in *Nature* that a report presented at the Newcastle meeting of the British Association last year directed attention to the lack of organization and general neglect of higher geodesy in the United Kingdom. The discussion upon this report led to the extension of the terms of reference of the committee so as to include, in addition to geodesy, other departments of geophysics, such as terrestrial magnetism, tides, atmospheric electricity and seismology. It was felt that steps should be taken to constitute a committee or association to promote the advance of the various branches of science which deal with the physical, metrical and dynamical properties of the earth, on both their theoretical and observational sides. Such a committee has now been appointed by the British Association and has arranged meetings for the discussion of geophysical subjects. The first meeting was held in the apartments of the Royal Astronomical Society on Wednesday, November 7, and will be presided over by the chairman of the committee, Sir Frank W. Dyson, the Astronomer Royal, who made a brief statement concerning the objects and future program of the meetings. The subject of magnetic surveys was introduced by Dr. S. Chapman, who made a report on magnetic surveys and charts by land and sea throughout the world. Dr. G. W. Walker gave an account of the recent magnetic survey of the United Kingdom made under the auspices of the Royal Society and the British Association. Major Lyons exhibited and described two of Gauss's heliotropes, on loan to the Science Museum. Among the subjects which the committee has under consideration for report and discussion at later meetings may be mentioned seiches and tides; atmospheric electricity; British earthquakes, observatories; methods and instruments in connection with the various branches of geophysics; geodetic and gravity surveys, and the constitution, temperature and other physical conditions, motions and secular changes of the interior of the earth.

According to the London *Times* the *Neue Zürcher Zeitung* recently published a review of German activities in technical matters in the field of war economics, in which it is stated that systematic investigations into the properties of pit coal have been carried on by the "Kaiser Wilhelm Institut für Kohlenforschung," and have yielded important industrial results. The treatment of coal with liquid sulphurous acid at ordinary temperatures has produced viscous, golden-yellow mineral oils, the amount produced being 5 kilogs, per metric ton. A process has also been elaborated by which through heating naphthalene under pressure, in the presence of aluminium chloride, an oil is produced which can be used for illuminating purposes in the same manner as petroleum. The utilization of lignite has been greatly extended. In the first place it is being used extensively as a fuel in the industrial establishments which have recently sprung up in the central German lignite fields, especially in the neighborhood of Bitterfeld and Halle a/S, where the

German air-nitrate factories are situated. A process has been discovered by which nearly twice the usual amount of ozokerite can be obtained from lignite, and the gas is being more extensively used for heating and smelting purposes.

Nature reports that one of the great captains of industry of Scotland has specially organized and equipped an engineering factory for the employment exclusively of educated women of good social standing instead of the usual woman factory worker, and with the fixed determination to carry on operations permanently under those conditions, the work to be taken up being that associated with the manufacture of internal-combustion motors. There is a fully illustrated account of the new factory in *Engineering* for November 9, from which it appears that it has some of the salient feature of a technical college combined with practical work in the factory, which gives that stimulus to study not realizable in the laboratory of a college. The factory is situated in the south of Scotland amidst beautiful scenery, so that students of botany and of wild-life generally can have full opportunity of pursuing their hobby. All the accessories which are now placed under the wide term "welfare" have been adopted to the fullest extent. Highly trained lecturers conduct classes at the works; these are compulsory. Entrants receive 20*s*. per week during the probationary period of six weeks; they then decide whether or not they intend to pursue the engineering career. If such be the case, and they are considered suitable, an apprenticeship agreement is entered into, and the wages become 25*s*. per week. Examinations are held at six months' intervals, and each "pass" means an increase of 5*s*. per week. It is evident that the whole scheme provides for women the opportunity of prosecuting an engineering career under the most favorable and stimulating conditions, and that the conditions are those best calculated for women of good education and social standing to attain a broad experience of engineering science and practise.

WE learn from the *British Medical Journal* that the Army Council has issued an instruction providing that students who at the time of their enlistment (whether they enlisted voluntarily or were called up under the military service acts) were actively engaged in medical studies and had completed the second year of their professional course, are, if eligible, and they so desire, to be transferred to the reserve, or discharged if ineligible for transfer to the reserve, for the purpose of resuming their studies with a view to obtaining a medical qualification. For the purpose of this instruction a man who had on or before enlistment completed two years of medical study, and who can within thirty-six months complete his professional curriculum and obtain his medical degree or license, is to be regarded as a third-year medical student. Students who do not pass the professional examination in anatomy and physiology within six months of resuming study will be recalled to the colors, and a student transferred to the reserve, unless he resumes his medical studies and enrolls in an Officers' Training Corps, will be recalled. Any third-year medical student who is desirous of being released from the colors under this instruction must apply through the usual channels, stating the date on which he desires to be released, and that he undertakes to resume his studies with a view to obtaining a medical qualification. A similar difficulty is being met in a different way in France. Owing to the prolongation of the war the supply of newly qualified men is drying up; casualties among medical officers have been numerous, the medical service in this respect coming next after the infantry. The French mobilization scheme provided that a medical student in a certain stage of the curriculum, reached usually at the end of the second year, should, when called up, be appointed médecin auxiliaire, a grade unknown in the Britsh army, but corresponding with that of surgeon probationer in the Royal Navy, which itself is the revival of the old grade of surgeon's mate. The case of medical students who have not advanced so far has recently engaged the attention of the Ministers of War and of Education, and of the General Staff, with the result that arrangements have been made by which medical students from the ranks may attend special courses of lectures

and eventually obtain credit for them when they seek a civil degree in medicine. Three schools of military medicine have been established for their benefit in regions behind the front, and have been duly provided with professors, libraries and laboratories.

UNIVERSITY AND EDUCATIONAL NEWS

REACHING a total of $515,486.09, federal grants of money to seventeen states under the Vocational Education Act were allotted at the meeting of the Federal Board of Vocational Education on December 21. Each of these states has complied with the terms of the law and has agreed to match every federal dollar with money publicly raised by the state or local community. The states are as follows: Alabama, Colorado, Florida, Iowa, Kansas, Michigan, Minnesota, Mississippi, Montana, Nebraska, North Carolina, Ohio, Oregon, South Dakota, Texas, Washington, Wyoming.

ACCUSATIONS of disloyalty against five members of the faculty of the University of Illinois were found on December 11 to be without grounds, by a subcommittee in a report to the board of trustees of the institution.

PROFESSOR G. H. SCOTT, for fifteen years professor of mathematics and astronomy in Yankton College, Yankton, South Dakota, has resigned to become principal of Benzonia Academy, Benzonia, Michigan.

FRANCOIS W. KIRKHAM, of the Brigham Young University, has been chosen director of vocational education for Utah, following the laying of plans to bring the state under provisions of the Smith-Hughes act.

DR. WRIGHT A. GARDNER, formerly associate professor of botany and plant physiologist at the Idaho University and Station, has been appointed plant physiologist and head of the department of botany at the Alabama College and Station.

DISCUSSION AND CORRESPONDENCE

A SUGGESTION FOR STAINING TECHNIQUE

WHERE one has many slides of sections passing through the various stages of dehydration and staining, a systematic method of labelling must be followed. Suggestions have been made to do this by means of a diamond point pencil or waterproof ink. Neither of these methods have worked satisfactorily for me—the first being too difficult to perform rapidly even after a good point has been procured and the marking being very difficult to read when covered with a dark stain. The second has these disadvantages and in addition the marking is very liable to rub off.

Therefore I suggest the following method which has worked satisfactorily for me while staining hundreds of sections at a time. Small aluminum clips with a numeral stamped or stencilled on each were prepared. These clips fasten on the edge of the slide when in the staining jars and are not large enough to prevent placing a cover on the jar. The data may be written in whatever manner desired in a notebook with the number or character to correspond to that on the aluminum clip. These clips are cheap, may easily be made and very few reagents ever used in dehydrations or staining attack the aluminum. The same clip may be used repeatedly.

PAUL ASHLEY WEST

TOLEDO, OHIO

A NOTE ON THE PREPARATION OF SKELETONS BY BACTERIAL DIGESTION

THE method of preparing skeletons by bacterial digestion is of long standing and has given excellent results. The present modification of the method was devised to obviate two objections which are of considerable importance when skeletons are prepared by students as class work. First, the digestion mass produces a foul odor and is disagreeable to handle, and, second, the digestion process, unless carefully controlled by frequent examinations is likely to result in displacement and subsequent loss of the smaller parts of the skeleton.

These objections are to a large extent overcome by embedding the roughly cleaned skeleton in a solid medium supporting bacterial growth. Agar-agar is preferable to gelatin, since it is not liquefied by the common bacterial enzymes. The method is as follows:

The skeleton of a freshly killed animal is more or less carefully cleaned of muscles and embedded in a plain agar solution (15 gm. per liter of water) which has been cooled to the pouring temperature (43° to 45° C.). The medium is allowed to solidify and the preparation is covered and set away at room temperature. The digestion requires from ten days to several weeks, depending largely on the extent of the preparatory cleaning. The time may be reduced by the use of incubator temperature. We have tried inoculating the skeletons with cultures of anaerobic proteolytic bacteria, but without great advantage.

The medium absorbs much of the odor and with suitably covered dishes it has been possible to leave the cultures standing in the laboratory. When the digestion is completed the bones can be conveniently dissected from the medium in their original relations. Washing the parts as removed completes the process. The skeletons thus prepared are very white, and bleaching is usually unnecessary. The method is best adapted to small skeletons, which can be embedded easily. It is these, however, which present the greatest liability to loss of parts in a fluid medium. The method promises to be particularly useful in the study of the cartilaginous skeletons of embryos.

RALPH G. HURLIN
BIOLOGICAL LABORATORY,
CLARK COLLEGE

SHALL THE USE OF THE ASTRONOMICAL DAY BE DISCONTINUED?

TO THE EDITOR OF SCIENCE: The question has recently been raised in England whether the astronomical day should not be set back twelve hours, so as to begin at midnight instead of at noon. It is stated by those advocating the change that the practical consideration of those using the Nautical Almanacs should prevail as against the usage of astronomers. The opinion of American astronomers has been requested and a committee of the American Astronomical Society has been appointed to collect information for presentation at the next meeting of the Society.

The committee desires to obtain an expression of opinion on this subject from as large a number as possible of astronomers, geodesists, surveyors, navigators, and all others who have occasion to use Nautical Almanacs.

Communications may be sent direct to Professor W. S. Eichelberger, Director of the Nautical Almanac, U. S. Naval Observatory, Washington, D. C., or possibly better to some journal, where a public expression of opinion may stir up further discussion.

W. S. EICHELBERGER,
Chairman

SCIENTIFIC BOOKS

The Microscope. By SIMON HENRY GAGE, Professor of Histology and Embryology, Emeritus in Cornell University. The Comstock Publishing Company, 1917. Twelfth edition, 472 pages, 252 text figures.

This standard work is so well known to American students that extended comment upon its usefulness or upon its special merits is superfluous. The twelfth edition has been more extensively revised and rewritten than any one of the earlier ones. While many new things are presented, nothing has been considered which the author has not personally tested and found practical. Among the more important new devices described are: (1) the single objective binocular for both high and low powers; (2) improved apparatus for drawing with the projection microscope; (3) perfected ray filters which make it possible to get photomicrographs of almost any microscopic specimen; (4) the use of "daylight" glass in microscopical illumination, and (5) the dark field illumination for all powers which makes it possible to study living structures in much greater detail than heretofore. Some subjects treated in the previous edition, such as metallography and microchemistry, which are now presented adequately in other available works, have been omitted. Because of its clearness and accuracy of statement, its well-chosen material, and its wealth of information, the book will without doubt continue to be the most widely used volume on the microscope in American laboratories.

M. F. GUYER

Introduction to Rural Sociology. By Paul L. Vogt. D. Appleton and Co., New York. 1917.

This book was written primarily as a text for college students interested in the social problems of small communities. The subject matter is what one would expect in such a book. The physical basis of rural life; the rural population, its movements, its health and its attitudes of mind; farmers' organizations, both social and economic; the established institutions dealing with country life, *e. g.*, the church and the school; and the relation of the village to the open country are the principal topics discussed.

Throughout the book it is very apparent that the author has been at great pains to make his work as accurate and comprehensive as possible. In both respects he has succeeded admirably, and that, too, without becoming tedious. In fact, I think the combination of the essentials of a text with a pleasing exposition will recommend the book to a rather large circle of readers outside of the class room.

A feature of the book especially worthy of notice is the thorough discussion of the relation of the village to the life of the open country. The author fully realizes that there can be no satisfactory development of agencies for the betterment of rural life unless village and farm cooperate and he has expressed this view clearly and convincingly.

No doubt reviewers will always feel that sins of omission are frequent. I am happy to say they are but few in the work under discussion. To my mind the most important omission is the failure to discuss the eugenic problems of the rural population and to give more attention to the natural movements of population due to the varying birth rates and death rates in different groups and in different sections of the nation.

In the numerous suggestions for the improvement of rural life occurring in almost every chapter the author shows sound practical sense. He knows rural communities at first hand. He knows their prejudices, their apathy, their strength and their weaknesses. One feels that the spirit of the writer would go far towards allaying the suspicion and the hostility so often encountered by those who would help to make the rural community a better place to live.

Warren S. Thompson

University of Michigan

SPECIAL ARTICLES

NOTE ON A WET CONDENSER SUITABLE FOR CONTINUOUS HIGH POTENTIAL SERVICE

In certain investigations necessitating long continuous production of a fat spark by means of a closed circuit transformer (1 K.W., 110 v. primary, 11,000 v. secondary) it was found that the glass plate condensers usually provided for this purpose repeatedly broke down owing to the heating under continuous performance. It occurred to us to substitute the ordinary glass with some glass having greater heat-resisting properties.

One liter, tall form, lipless "Pyrex" beakers were accordingly covered with tinfoil as carefully as possible, both on the inner and outer surfaces. These were then mounted by placing the edge into a groove in a board and sealing in with rosin. Condensers of this kind were tedious to make, and proved quite a problem to mount securely. The labor involved in producing a set of the required capacity stopped work in this direction.

The final form of condenser which has proved very serviceable for the work in hand was that in which the "Pyrex" glass beakers mentioned above constituted the dialectric, and a nearly saturated solution of common salt constituted the conductor plates. The beakers were filled to within 2.5 cm. of the rim with the solution, and were immersed to a similar depth into the solution contained in an earthen vessel, a 8 gallon crock. The beakers measure 9 cm. in diameter, 19 cm. high, 16.5 cm. effective height, thickness, about 1.2 mm. The twenty beakers used were selected from a stock of about 100 in order to avoid flaws, particularly bubbles. The stock was a little old and therefore probably not as good in evenness of surface and homogeneity of material as that now being manufactured. It was not pos-

sible to avoid such defects entirely, but it is interesting to note that no beaker has proved defective after very long and severe use.

The place subjected to greatest danger of puncture and that which allows greatest leakage is where the exposed surfaces of the solution inside and out come in contact with the surface of the beakers. This defect can be reduced considerably by filling the beakers with the salt solution to a slightly different level from that of their containers. Care should be taken not to wet the portion of the beaker that is not immersed. To eliminate sparking quite completely, however, the surfaces of the solution inside the beakers and that surrounding the beakers were covered with a layer of oil 5 cm. deep. For this purpose a 300-degree mineral seal oil was used. This oil, as Mr. C. E. Skinner kindly informed us, has very good dialectric properties—as good as can be expected from an oil not free from water. Whether this layer of oil eliminated sparking at the sacrifice of some capacity we have not determined.

The capacity of these condensers was estimated by the method of divided discharge and by the method of mixtures. The capacity of each of the five jars containing four beakers each was: .0088 M.F., .0091 M.F., .0093 M.F., .010 M.F., .0088 M.F. respectively. The mean of these capacities is .0092 M.F. A similar estimation of the capacity of two such beakers covered with tinfoil indicated that their combined capacity was very appreciably less than two beakers of the wet condenser. This is probably due to the unevenness of the surface and the difficulty of making contact between the glass and the tinfoil.

A comparison was made between the wet condenser as above described in which beakers of Jena glass and of "Pyrex" glass were used. The dimensions of these beakers were approximately the same. Assuming that the average thickness of the "Pyrex" beaker is equal to that of the Jena and assuming the dielectric constant of Jena glass to be 6.5, that of "Pyrex" glass must be about 4.3.

A comparison was also made as to the influence of the character of the conducting medium. Beaker condensers were set up using mercury, concentrated salt solution and distilled water (iron still), respectively. The capacities of the latter two were equal within the limits of error of measurements, while the capacity when using mercury was 10 per cent. higher than when using the salt solution. The slight superiority of mercury at low constant potential seems to be very greatly enhanced at the high and discontinuous potentials employed to produce the spark, where, judging by the fatness of the spark, the capacity of the condenser with mercury is three or four times as great as that of the condenser with salt solution.

This wet condenser has given perfect satisfaction under severe use for many months. Its cost is approximately the same as the glass plate condenser and considerably less than similar condensers covered with tinfoil.

E. KARRER,
H. S. NEWCOMER
THE PHYSICAL LABORATORY OF THE UNITED GAS IMPROVEMENT COMPANY,
THE LABORATORY OF THE HENRY PHIPPS INSTITUTE OF THE UNIVERSITY OF PENNSYLVANIA
PHILADELPHIA, PA.

BOSTON MEETING OF THE AMERICAN CHEMICAL SOCIETY. VI

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

H. E. Howe, *Chairman.*

S. H. Salisbury, Jr., *Secretary.*

Conference on "The Industrial Chemist in War Time"

The cracking of solvent naphtha in the presence of Blau gas: GUSTAV EGLOFF. Solvent naphtha derived from the thermal decomposition of coal was passed through a carburetted water gas set in the presence of Blau gas at a temperature of 850° C. to produce toluene. The solvent naphtha used gave a distillation range of 93 per cent. between 130° C. and 165° C. First drop at 128° C. and dry at 183° C. Distillation determined by means of a 100 c.c. Standard Engler flask. The percentage yield of toluene in the recovered oil was nineteen, and upon the basis of solvent naphtha used eleven and one half per cent.

The effect of pressure upon the formation of benzene and toluene from gas oil: GUSTAV EGLOFF. Gas oil derived from a Pennsylvania crude petroleum was subjected to pressures of one, eleven and eighteen atmospheres at constant temperature of 700° C. to form benzene and toluene. The following table tabulates the analytical data:

700 deg. C.

Atmospheres Pressure	One	Eleven	Eighteen
Specific gravity recovered oil	0.891	0.970	0.998
Per cent. of recovered oil	13.3	25.0	18.0
Per cent. benzene in recovered oil	11.3	22.3	22.4
Per cent. of toluene in recovered oil	7.5	15.1	12.9
Per cent. of benzene on basis oil used for production	1.5	5.6	4.1
Per cent. of toluene on basis of oil used for production	1.0	3.8	2.3

An experiment in scrubbing carburetted water gas from recovering aromatics: ROBERT J. MOORE and GUSTAV EGLOFF. The following tables cover the percentages of benzene, toluene and xylene obtained by scrubbing one thousand cubic feet of carburetted water gas, using a paraffin "straw" oil as absorbent medium.

PERCENTAGES OF BENZENE, TOLUENE, XYLENE AND UNSATURATEDS IN LIGHT OIL OBTAINED

Cut Deg. C.	Per Cent. by Vol.	Spec. Grav.	Per Cent. Unsat.
Benzene (to 95)	51.8	0.866	46.0
Toluene (95 to 120)	24.1	0.869	18.0
Xylene (120 to 150)	6.0	0.868	24.0

AROMATICS RECOVERABLE FROM 1,000 CU. FT. OF GAS

	Liters	Gallons
Benzene	0.267	0.0707
Toluene	0.242	0.0640
Xylene	0.062	0.0163

In view of the fact that the annual production of carburetted water gas is in the neighborhood of 150 billion cubic feet the above figures assume an added significance.

Deposition of silver films on glass: ALEXANDER SILVER and RAYMOND M. HOWE. A paper dealing with the study of various reactions involved in depositing silver films on glass from ammoniacal silver solutions by the use of aldehydes in the presence of alcohols and sugars. By modifying the old Liebig method it is found possible to produce perfect silver films on glass through the introduction of alcohols and sugars, the mirrors forming in the cold. The rate of deposition is controllable. The cost of mirror production is lowered considerably and the efficiency of the process as developed is higher than that of any of the older methods in use.

Some notes on chars and other solid decolorizing agents: CHARLES E. WOOD. The decolorizing effects on sugar solutions of bone char, animal and vegetable chars and several other kinds of carbon, including lamp black and aquadag are compared with one another and with fuller's earth and clay. A brief statement as to optimum conditions of manufacture and use is given and a few theoretical considerations are brought together.

Comparative tests of porcelain laboratory ware: C. E. WATERS. Five kinds, which were all that could be obtained, were tested: two American, two German and one Japanese. One German and the two American wares did not stand up well when heated to 225° C. and quickly cooled by floating on water at room temperature, or when suddenly heated in the flame of a Fletcher burner. There was not only actual breakage, but in many cases the glaze cracked under the tongs when a hot piece was picked up. The solubilities in hot solutions of sodium hydroxide and carbonate, in nearly boiling concentrated sulphuric acid, in fused sodium nitrate and in a fused mixture of this salt and the carbonate, were comparatively slight. In this respect there is little choice between the five brands. Ferric oxide, when ignited in a thin layer over the bottom of the dish, stained the glaze, but was readily removed by digestion with hydrochloric acid. The loss in weight under this treatment was so small that there could have been little or no formation of an easily soluble silicate.

Comparative tests of chemical glassware: PERCY H. WALKER and F. W. SMITHER. Composition, coefficient of expansion, refractive indices, condition of strain, effect of heat and mechanical shock and resistance to various chemical reagents were determined on seven kinds of glassware, which bear permanent manufacturers' trade-marks, and which are offered for sale on the American market. Two of these kinds of glass were of foreign manufacture. The tests, which were intended to furnish information as to the relative values of the different makes of glass for laboratory operations, show that the five kinds of American-made ware are distinctly superior to one of the foreign brands and at least equal to the other foreign brand.

SCIENCE

FRIDAY, JANUARY 11, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME ECONOMIC ASPECTS OF THE WORLD WAR. II

The Espionage Act and the Trading-with-the-Enemy Act

Under the Espionage Act and the Trading-with-the-Enemy Act all exports and imports are placed under the control of the President with authority to delegate his powers. The control of exports was first exercised by the Exports Council, later by the Exports Administrative Board. This power still later passed to the War Trade Board, and there was added the control of imports. Orders have been issued so that at the present time the exportation and importation of all commodities of importance are completely controlled. The exportation of some is altogether prohibited and others prohibited except to our associates in war. Imports are likewise controlled in an appropriate fashion. Trade is altogether prohibited with the enemy or ally of the enemy; and with some 1,600 firms in neutral countries.

These regulations are exercised through licenses; and there is absolutely no exportation or importation of goods except by those who have licenses approving the particular transactions.

The Railroad

The Priority Administration is organized under the Priority Act. This act compels the railroads of the United States to handle all the transportation business of the country as the President directs. Under the act the President appointed Judge Robert S. Lovett Priority Administrator. In his work the administrator has had the cooperation of the carriers, of the Inter-

state Commerce Commission, and of the other special war administrations.

The Priority Administration has given a number of special orders for preference in shipment, and finally has issued a general priority order, which indicates the precise preference in handling the commodities which are necessary directly to carry on the war or indirectly to support the carrying on of the war, such as food, feed, and fuel. In short, the railroads must first provide for all of these needs in the order prescribed, ranging from steam railroad fuel through foods, to fuel necessary for domestic purposes, the public utilities, and for essentual manufactories, etc. Only after these needs of transportation are provided for can the railroads handle other business.

In obeying the directions of the priority administration, the railroads are, by the terms of the Priority Act, freed from the penalties of the Sherman and other anti-trust laws.

The situation above described in regard to transportation was that in force until December 28, 1917, at which time everything was changed by the action of the President herein summarized.

In the act approved August 29, 1916, making the appropriation for the support of the army for the year 1916–17, the President was empowered through the Secretary of War to take possession and assume control of the transportation of the country for war purposes; and also "for such other purposes connected with the emergency as may be needful or desirable." A state of war was declared to exist between United States and Germany, April 6, 1917, and between the United States and Austria, December 7, 1917. Based upon the power vested in him by the above measures, the President on December 26, 1917, by proclamation, took over the entire railroad system of the country and also the boats which are operating in connection with such railroads. The proclamation not only applied to the railways, but to the terminal companies and all the equipment of the railways of every kind. William G. McAdoo was appointed Director General of the Railroads. The proclamation became effective December 28, 1917, at 12 o'clock, noon, and the transfer of accounting took place at 12 o'clock, midnight, December 31, 1917.

Upon December 29, the Director General issued his first order. It was directed that the transportation system covered by the proclamation shall be operated as a national unit and that all facilities shall be used so as to give the highest efficiency. Routes designated by shippers are to be disregarded if these would interfere with the speed of transportation. Traffic agreements between carriers are not to interfere with the expeditious movements of freight. Through routes which have not heretofore been established because of short hauling or other causes are to be established and used wherever expedition will be promoted.

On January 4, 1918, the President addressed Congress in regard to the action which he had taken. He recommended that the compensation of the railroads for the service during the time they are under the management of the government should be the average of the net railway operating income for the three years ending June 30, 1917, and that the owners of the stocks and bonds of the railroads be guaranteed that they would receive this income.

On the same day a bill was introduced into Congress which proposes to carry out this recommendation. The measure also provides for an appropriation of $500,000,000 as a rotating fund to operate the railways and to provide for the necessary additions, betterments, rolling stock, etc.

Many other features are embodied in the bill which it is not necessary to discuss. The control of the transportation system is to continue for the period of the war, and thereafter until otherwise ordered.

Taking over the transportation system of the country and operating it as a unit makes without force all of the antitrust laws. Instead of prohibition of the cooperation of the railroads, pooling, etc., there is a positive order that there must be the most perfect combination of all of the facilities of the country to give the highest efficiency. So far as the railroad system of the country is concerned, the antitrust laws are abolished for the period of the war.

The War Industries Board

The War Industries Board is a creation of the Council of National Defense. At the request of this board the producers agreed to maximum prices for copper, and for the more important forms of iron and steel. The prices fixed are the same throughout the country, except such allowances as are made for differentials due to freight, etc. Since the demand exceeds the supply, the maximum price is the price which obtains. Therefore producers of copper, iron, and steel sell at a definite price without regard to who is the purchaser. Competition in price is completely eliminated.

These agreements have been approved by the President. They have therefore the sanction of the law so far as the purchases of the government are concerned, since Section 120 of the National Defense Act authorizes the President to fix the price of all commodities for the government necessary for the prosecution of the war. But agreement upon prices for copper, iron and steel paid by the public have no warrant in congressional action.

The prices are large reductions from those which obtained before the agreements were made, but are much higher and in many cases at least twice as high as those which prevailed in the pre-war period.

Also, by the request of the War Industries Board, the manufacturers have agreed to a definite order of preference. Under this priority agreement, first are to come war orders; second, those which are, while not directly for the war, of public interest and essential to the national welfare; and third, unessential commodities. Each manufacturer obtains permission of the War Industries Board to execute any order, and further executes its orders in accordance with the preference rules of the board.

Thus the War Industries Board through request has secured not only the agreement of the manufacturers in regard to the prices of steel, iron, and copper, but the preference in which the work is done. The steel and copper businesses are regulated to a large extent in the same manner as food and fuel are controlled in consequence of Congressional enactment.

Regulation by the Federal Court

The Federal Trade Commission by the direction of Congress investigated the print paper business and reached the conclusion that the control of this industry should be taken over and operated by the government during the war, and so recommended. Action by Congress upon this recommendation is pending.

In the meantime the Attorney General brought suit against the News Print Manufacturers' Association under the antitrust laws. The suit was not contested and the court issued a comprehensive order that the Manufacturers' Association should be dissolved. The Association and a number of its officers were fined. At the same time this was done the court entered into an agreement with each of the firms making up the Association, some forty in number,

in regard to the maximum price which should be paid for the different kinds of print paper for a period of three months, and after that term delegated the same authority to the Federal Trade Commission to the end of the war and three months thereafter.

All the members of the dissolved association entered into a contract with the court to execute this agreement. The manufacturers agreed with the court in the fixing of maximum prices throughout the country. Since, however, the demand is in excess of the supply, these maximum prices are in fact the prices everywhere paid.

Thus by court action, without any change of the law, the same results are reached for the control of prices of paper as are reached by the Food and Fuel Administrations concerning food and coal in consequence of the law and by the War Industries Board for the control prices of copper, iron, and steel. The reason given by the court for the exercise of this authority was, that in the present condition of affairs in the United States, it was desirable that some adjustment of the controversy be made.

THE PRINCIPLES UNDER WHICH MAXIMUM PRICES HAVE BEEN FIXED

In all of the price regulations, the board or other agent has had the very delicate task of so fixing the price that there will be a very large production without raising it so high as to be unreasonable. With liberal prices there is a strong incentive to increased production. If the price of a commodity were not only liberal but very high, the production might be still further slightly increased; but this final increment would not be sufficient to compensate for the higher price for all of the commodity to the public.

There is difference of opinion concerning the soundness of judgment which has been exercised in price control; but it is noticeable that the criticism has been from both sides. The producers have held that the prices are not adequate; the consumers have felt that they are too high. As an illustration of the former, it may be mentioned that there is discontent among the farmers with the price fixed for wheat, although this is more than twice as high as that before the war. Similarly some of the coal producers have held that the prices which have been allowed are too low, although they are upon the average more than twice as high and in many instances thrice those that obtained before the war; and the profits of the operators are unquestionably much greater. On the other hand, the consumers have felt that the prices fixed for copper, iron, and steel are very high, yielding as they do enormous profits to each of the great producers.

It is, however, to be said that in all cases the administrative responsibility, in controlling prices, has been exercised by a group of men which has included representatives of producers, distributers, and consumers, and presumably upon the whole they have been determined as nearly right as is practicable for human beings acting under the stress of a great national emergency.

The regulatory measures have demonstrated that under a proper system, maximum price control is practicable; and, therefore, in the future, discussion should be limited to the question as to whether or not such price control is expedient; that is, whether or not it is advantageous or disadvantageous to the public.

Whenever, heretofore, price fixing has been advocated it has always been met with the objection that the proposal is impracticable. It has been said, if the government fixes prices, secretly they will be disregarded. This theoretical objection must

now face facts. The maximum price for wheat and its products, for fuel of different classes; for copper, iron, steel; and for print paper, have been controlled by governmental action; and these are the prices under which substantially all transactions have been carried on. There have been minor variations from those fixed, as illustrated by secret excessive charges for sugar; but as soon as such cases have become known, prompt punishment has come by compelling restitution or revocation of licenses. Excluding from consideration those dealings which have been made under contracts enforceable in law and made prior to the promulgation of regulatory measures, it is safe to say that more than 95 per cent. of the dealings in commodities in which maximum prices have been fixed have been within those prices.

It is to be noticed that this success has not been achieved simply by enacting regulations in regard to the maximum prices and leaving to the police offices and courts the problem of enforcement. All such attempts at price regulation have failed; and any similar future attempt would be certain to fail; just as the laws against discriminations, rebates, drawbacks, etc., for the public utilities failed as long as left to the courts for enforcement. These latter measures succeeded when an agency was created—the administrative commission or board—whose exclusive duty it was to see that the utilities laws were obeyed.

In the case of the present sucessful price-fixing movement, the controlling agencies have even greater powers than the utilities commissions. Through the license system, they inquire into charges and limit them at each stage of the process of distribution. For wheat and coal, the agencies have had also the authority to buy and sell the entire product of the country; and, for wheat, the power has been exercised to the extent necessary to accomplish the desired end.

Therefore, the regulatory movement developed during the war has shown the way in which the principle of maximum price fixing can be carried out. This is not the least of its achievements; for no one supposes that maximum price-fixing can succeed, administered in an arbitrary manner and irrespective of cost. It was the combination of the exercise of broad powers through licensing, careful inquiry into cost, and giving due consideration to the necessity for large production that success in price control has been obtained.

REGULATORY MEASURES AND THE ANTITRUST LAWS

The facts presented show that for food, fuel, copper, iron, steel, paper, and transportation by land and water, the principles embodied in the Sherman and other antitrust laws are directly contravened.

The fundamental ideas of the Sherman Act are that trade is controlled by the law of supply and demand and that in manufacture and transportation all are on an equal footing. Commodities are to freely flow as required by competition. If there is a shortage, the highest bidder will have his necessary needs met. There must be no cooperation in distribution. The common carriers must show no discrimination in goods. If there is cross freight, this is immaterial. The carrier must ship the goods as asked by the shipper.

Every one of these principles is directly violated under the control exercised through the war measures. Prices instead of being variable are the same for the same commodity at the same locality. For wheat the price is to be neither higher nor lower than that fixed by the Food Administration. For fuel, copper, iron, and steel, only maximum prices are fixed, but since the

demand exceeds the supply, the maximum prices are those in fact everywhere paid. The difference in prices for a commodity at different localities is only that necessary to compensate for freight differentials and other conditions.

In the matter of distribution, commodities do not go to the highest bidders but to the persons and places indicated by the control. The wheat and sugar remain at home and are sent abroad in proportions decided by the Food Administration. Fuel is furnished to the government and to corporations and individuals as decided by the Fuel Administration. Copper, iron, and steel are first to go directly to war purposes, then to purposes which are indirectly to assist in the war, and only what is left may go to unessential industries.

If the prosecution of the war is best furthered by so doing, commodities are sent abroad. If to do this it is necessary to curtail the home consumption, this is done. The control of exports and imports through licenses is completely in charge of the War Trade Board. The common carriers instead of acting independently and handling goods without discrimination must so coöperate in avoiding cross haulages as to give the highest efficiency; and they must handle goods in the order that the director general indicates.

In short, there is governmental control of many phases of industry and commerce for a number of the most essential commodities.

By express act, any form of cooperation in shipping which meets the approval of the Shipping Board, even to the extent of pooling, is exempted from the antitrust laws. The same is true for the railroads acting in accordance with orders of the Priority Administrator. No such express exemption is made for the agreements in regard to food and fuel. It is to be presumed that for these commodities the enactments of the food and fuel laws by Congress may be construed as repealing the anti-trust acts so far as the particular authority of these laws goes. Thus the fixing of the price of wheat and the control of wheat as a government monopoly are authorized by law enacted later than the Sherman and other antitrust acts; and they, therefore, in effect repeal these laws as far as these transactions are concerned.

However, for the transactions of the War Industries Board, there is no express law authorizing the copper, iron, and steel men to agree upon prices and to recognize priority. This board makes requests rather than issues orders. The price fixing is by agreement. These agreements may have the sanction of law by implication, so far as the purchases are by the government under section 120 of the National Defense Act. But it is clear that in agreeing upon prices for the public, the copper, iron, and steel men are violating the antitrust laws, and they are so doing by request of the War Industries Board, an instrument of the National Council of Defense, and with the approval of the President.

Incongruity of the Regulatory Measures and the Antitrust Acts

At the very same time these agreements are being made and are in force, the United States Steel Corporation is before the United States Supreme Court, charged with violating the antitrust laws by cooperation in controlling prices. Even if the charges are fully sustained, they do not go so far as the cooperation of the copper, iron, and steel men in response to the request of the government. Is this not indeed an extraordinary anomaly?

If the Steel Corporation is dissolved by the Supreme Court in consequence of the prosecution of the Attorney General, this

dissolution will be caused by actions less in violation of the law than those which the Steel Corporation has subsequently done at the request of the War Industries Board.

But the most curious anomaly of all is that in regard to book paper. The manufacturers of book paper are indicted for price fixing. The organization under indictment is dissolved and several of its members are fined. The court itself then enters into a contract with these same manufacturers to fix for three months the maximum price for print paper at somewhat lower rates than those fixed by the combination itself. The contract grants authority to the Federal Trade Commission to continue maximum price fixing throughout the war and three months thereafter.

Regulatory Measures Beneficial

Few, I suppose, will question that the regulatory measures authorized by law and those taken, without such authority, have been not only a benefit to the people but essential for the successful prosecution of the war. They have resulted in checking the enhancement of prices for essential commodities which, before these regulatory measures were enforced, were sailing skyward. Not only have rising prices been checked, but for many of the commodities they have been reduced—for food, fuel, and paper, moderately, and for copper, iron, and steel, largely. Also great economies have resulted from dividing orders among the different plants in such a manner that each does the work for which it is best fitted and nearest the location at which the commodity will be used. Already great additional economies have come from operating the carriers in such a manner as to reduce cross haulage and to lessen congestion. Also through the future operation of the railroads of the country as a unit under a Director General vast additional economies are certain to be introduced.

The diversion of the wheat for export to the South instead of through the congested centers of the North and the East at a time when the transportation facilities of the country are taxed to the utmost is a vast economic gain. Also the diversion of the coal to the upper lake ports in advance of the closing of navigation will prevent great hardship which otherwise would have been inevitable.

Thus the majority of people will agree that the authorized exemptions from the antitrust laws, the exemptions from these laws by implication, the ignoring of them by the War Industries Board, and the action of the Court in enforcing them against the manufacturers and itself violating them, have all been beneficial.

Reconciliation of Anomalies

But the question arises whether all of these anomalies can be reconciled. The answer is yes. Amend the first section of the Sherman antitrust act, which forbids restraint of trade through combination and contract or by monopoly, by adding the clauses, "The restraint of trade meant by this act is that restraint of trade which is detrimental to the public welfare; and the presumption is that any restraint of trade is thus detrimental and to become legal must be approved by an appropriate governmental agency." Without special exceptions, if this amendment were made, it would legalize the cooperation of shipping, the cooperation of the railroads, and the actions of the Fuel and Food Administrations, the War Industries Board, and the Federal Court.

The facts presented show that cooperation by combination, contract, or monopoly may be beneficial or detrimental. Too frequently, when the control of the market

and monopoly have been in private hands without regulation, it has been detrimental; indeed so detrimental that this led to the enactment of the antitrust laws. When the control of the market or monopoly is, however, subject to governmental regulation, it may be highly beneficial; not only beneficial, but at a time of war, absolutely essential. The sanction, as far as public opinion is concerned, of all of the regulatory measures in regard to ships, railroads, food, fuel, copper, iron, steel, and paper, is that they have been a benefit to the people and have been essential for the successful prosecution of the war. There would have been no question about the legality and propriety of these acts, had the Sherman Act been amended in accordance with the suggestion made.

THE CONTINUATION OF REGULATION AFTER THE WAR

All the regulatory measures considered are for the duration of the war or for a limited period thereafter. If no action is taken by Congress, they will expire at varying intervals following the conclusion of peace.

Future Regulation to be based upon the Public Interest

The regulatory laws discussed are all based upon the war powers of Congress. In each one of them it is declared that the act is necessary for the public security and defense. If they are to be continued after the war, it must be upon the basis that the matters with which they deal are affected with a public interest; that is, the regulation, if continued, must be on the same principle as that which applies to the public utilities. Many of the utilities have received special privileges involving franchises; but irrespective of this, it is well established that regulation may be applied to any business which is affected with a public interest. This goes back to the grain-elevator case, in which this broad principle was definitely settled. Can any one doubt that the business of an organization which controls half of the iron ore resources of the country, a large percentage of the coking coal, and manufactures half of the iron and steel of the nation is affected with a public interest? Or that the same is true of dealings in the most fundamental food commodities, such as wheat, sugar, meats, and fats? Therefore, undoubtedly Congress has the power to continue the regulatory measures after the war. This then raises the question should they be allowed to expire or be continued. The obvious general answer is that so far as they will be beneficial to the public they should be continued, but so far as they will be detrimental they should terminate. The difficulty will be in indicating those measures which under normal conditions will be beneficial and those that will be detrimental. In considering this problem, there are certain general considerations which should have weight.

Regulation Necessary to meet Foreign Competition

It is certain, that, following the war, combination abroad will be general. Already Germany is considering buying and selling nationally; and whether or not she decides to do this as a direct governmental activity, there is no question that the trading by Germany in any commodity will be done, if not through a single organization, at least through such a limited number that they will perfectly cooperate in their production and distribution.

Furthermore, it is highly probable that this cooperation will be extended so as to include her allies. Under these circumstances it is certain that any attempt to

meet Germany in world trade through the individualistic method under the law of supply and demand can not have the highest success. If we do not meet Germany's competition by national organization as efficient as her own, we may as well at once concede that Germany will gain a predominant position for those industries for which she has adequate resources.

Already this has been appreciated by Congress; and there is now in conference the Webb bill which, if enacted, will permit cooperation in foreign trade. This bill proposes to remove the handicap in selling goods abroad; and thus is in the right direction. It does not, however, permit cooperation in production within the United States; whereas such cooperation through cartels is legal in Germany. This powerful advantage Germany will retain. But if to meet this situation it be decided to permit cooperation within the United States, regulation is inevitable. If industry and commerce are freed from the restraints and penalties of the antitrust laws, there must be governmental agencies that shall see that advantage is not taken of the public in consequence of this fact.

Continuance of Regulation required to meet Needs of Allies

There is still another aspect of the question of continuing regulation which requires consideration. For a considerable period after the war, the demand for food and other essentials will be excessive. The cereal production of Great Britain, France and Italy has declined alarmingly during the war, because of lack of fertilizers and insufficient labor. Their herds are greatly depleted. These tendencies will continue throughout the war, so that their agricultural production will become even smaller. It is probable that for a long time, possibly for several years, we may have an insufficient surplus to even meet the legitimate needs of our associates in war; indeed it is little short of certain that this will be true for a number of commodities.

Shall we revert to the law of supply and demand under competition, and allow goods to be exported in unlimited quantities and without preference?

I do not know the answer others will make, but, for myself, it seems clear that the necessities of the allies must be met not only during the war, but for a sufficient period after the war so that their agriculture and industries may be rehabilitated; especially as such rehabilitation in Belgium, northern France and Serbia, is largely necessary because of ruthless and unecessary destruction of property on a vast scale by the Central Powers and because of heavy drafts upon their financial resources wholly unwarranted by international law.

If the country accepts the answer suggested, it will require at the least that exports be controlled. Also if I am correct in believing that the demands for essential commodities after the close of the war will exceed the supply, the control of prices must continue, otherwise there will be another period of runaway prices; and with the present base from which it would start, this is not to be considered.

Continuance of Regulation will avoid Government Ownership

No thoughtful man can doubt, whether or not he believes in the extension of regulation, that great economic changes are inevitable following the war. The growth of the socialist group, heretofore mainly confined to other countries, will expand in the United States. Experiments on a gigantic scale of public control and even public operation of manufacture and commerce have been made in European countries engaged in the war and of less magnitude in

the United States. Also it has been demonstrated that in many directions, under the system of cooperation, efficiency and economy have been very greatly increased and unnecessary wastes reduced. With the mighty burden of the war debts upon us it will be absolutely necessary to continue this efficiency and economy. Therefore in advocating the continuance of the use of the principle of regulation for those fundamental commodities essential to the very life of the people or in the legal phrase vested with a public interest, I believe I am advocating the policy by which we may escape government ownership and operation.

For my part I am very reluctant to see the management of the industries of the country fall into the hands of a governmental bureaucracy. The emergency situation, due to our unpreparedness, when we entered the war, was met in large measure by the voluntary service to the government of thousands of our ablest men from business and many other walks of life. Under the extraordinary stress of the nation, incited by highly patriotic motives, they have left their private affairs and have taken positions wherever the country called. Their service is unbought. They are exerting their utmost energy for our country, and this will continue during the period of the war. But when the war ends, they will rightly return to their own affairs. They will not become a permanent part of government bureaus.

Heretofore agriculture, industry and commerce have been under the leadership of able men who have reached their positions as a result of the competition of ability. The citadel of defense of private property is that the system develops initiative and energy. These qualities give large rewards to the men possessing them. The central point at which private property is attacked is that strong men use their powers for their own ends. The captains of industry have too often exercised their control without sufficient regard to the public interest.

What I am proposing is that property remain in private hands and that exceptional initiative and energy have exceptional reward, but that so far as business and industry are vested with a public interest they be subjected to regulation. Under this plan, those who controlled vast properties would necessarily exercise that control with due consideration for the masses of the people.

We should then have both the advantages of private property and the protection of the public. Should not this plan, both for the utilities and the essential commodities vested with a public interest be thoroughly tried out before we place the control of productive industry and commerce in the hands of governmental bureaucracies?

The Extent to which Regulation should be continued

In advocating the continuance of regulation after the war, I do not mean to imply that all the existing measures shall be retained in their present forms. It is yet too early to suggest a program in regard to the extent which this should be done. What I am advocating is that we maintain the principle that the essential commodities are subject to control in the public interest precisely as are the utilities. That principle recognized, regulatory measures should be continued only as far as necessary to meet the existing world conditions. In the further development of the policy of regulation we should proceed cautiously as occasion arises precisely as we did in the control of the public utilities.

CONCLUDING STATEMENT

This World War probably will cost hundreds of thousands, and it may cost millions of our men. It will require many billions of our treasure. This will put a heavy burden upon succeeding generations. The dreadful costs of the war we must bear. Should we not therefore gain everything possible from the experiences of the war? The vast savings due to more scientific production and distribution, if continued after the war, will in large measure, indeed, they may completely, carry not only the interest load imposed upon us, but even furnish a certain amount each year toward the liquidation of the principal. Without being able to demonstrate it, I believe it probable, that if, following the war, wise governmental regulation is continued for essential commodities as well as the utilities, the savings of the people may be sufficient to meet the money cost of the war. Nothing can compensate for the losses in men.

CHARLES R. VAN HISE
UNIVERSITY OF WISCONSIN

SCIENTIFIC EVENTS

AMOS PEASLEE BROWN

RESOLUTIONS were passed at the last meeting of the faculty of the Towne Scientific School of the University of Pennsylvania on the death of Professor Amos P. Brown as follows:

WHEREAS: In the death of Amos Peaslee Brown, for many years the professor of mineralogy and geology in the Towne Scientific School, the university has lost an honored and able scholar and original investigator; the faculty of the Towne Scientific School wishes to record its sense of the loss to this faculty and to the university, and to express also its sympathy to Professor Brown's family.

Amos Peaslee Brown was born in Germantown, December 3, 1864. He graduated from the Towne Scientific School in 1886, with the degree of Bachelor of Science; he received the degree of Doctor of Philosophy in 1893. He subsequently became by advancement through various grades professor of mineralogy and geology in the University of Pennsylvania, holding this position until his retirement in the winter of 1916–17.

Dr. Brown was a man who by his fine personal character and high aims, and by his lovable disposition won warm and enduring friendships. His work while well known among scientific men did not attract publicity; he did not wish that it should, he was rather of the scholarly type which quietly, studiously and accurately pursues his chosen field. By reason of his philosophic and analytic mind, Dr. Brown was able to make specific application of his knowledge to the problems of other fields of science besides his more immediate one of the geological sciences.

His work carried him into the laboratory and field alike. He was the first geologist to visit and report on the geological formations of considerable general geological importance. He was at intervals connected with the Second Geological Survey of Pennsylvania. His papers cover a wide reach of general and specific scientific character.

Among the most notable recent investigations in America was the work done by Professor Brown in the field of crystallography; specifically the investigations in the classes of crystals found in the hemoglobins of the entire range of the vertebrate animals. In the course of this investigation Dr. Brown prepared, examined and calculated the functions of thousands of intricate and minute crystals, deducing from them conclusions highly important alike to organic and inorganic science. This work, carried out in collaboration with Professor Reichert, of this university, is one of the greatest contributions to exact science ever made in this country and is a lasting adornment to the fame of the University of Pennsylvania.

This faculty, therefore, in the realization of the loss to the entire university in the untimely death of their late colleague, passes this resolution of its appreciation of the man and of the loss to the University of Pennsylvania.

WORK OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS[1]

IN March, 1917, the committee arranged, in conjunction with the National Research Coun-

[1] From the annual report of the executive committee of the National Advisory Committee for Aeronautics.

cil, for representation on the foreign committee sent abroad by the National Research Council to obtain detailed information on scientific matters of importance in connection with the war, and Dr. Joseph S. Ames, member of this committee, was appointed such representative.

In order to further develop contact with sources of information from abroad, Lieutenant Colonel L. W. H. Rees, R. F. C., member of the British commission, together with Major Joseph Tulasne, Captain de Guiche, and Captain A. de La Grange, of the French Flying Corps and members of the French commission, were made associate members of the committee, and as such attended its meetings, contributing valuable information and suggestions regarding matters with which they were especially familiar.

Previous to the entrance of the United States into the present war the committee had undertaken a census of the production facilities of manufacturers of aircraft and aeronautic engines, which information was made available for use of the Aircraft Production Board at the beginning of its work in April.

In October, 1916, the committee took under consideration the question of the selection of a suitable site for the committee's proposed experimental laboratory. At the suggestion of the War Department this committee inspected several proposed sites and made recommendation to the War Department for the purchase of one of them, which recommendation was accepted by the War Department and the site was purchased.

On this field the War Department has allotted to the committee a space suited to the erection of the committee's proposed research laboratories. The committee has designed the first building of the group contemplated and it is now in the course of construction.

The committee has cooperated with the Aircraft Production Board in connection with a wide variety of problems relating to the design, specifications, and tests of aircraft. The committee has now in hand a most important investigation on the use of steel for airplane construction and is supervising the development of a design for construction in steel, to be later subject to a program of tests intended to show the possibilities of such type of construction.

In the field of power plant design and construction for aircraft, the committee has cooperated with the Bureau of Standards in the design, construction, equipment and operation of a large vacuum chamber engine testing laboratory which is intended to reproduce the conditions of aeronautic engines operating at high altitudes. This equipment has been installed with special reference to the development and improvement of the "Liberty" engine and important investigations bearing on this problem are now being carried forward. The committee has also carried on a number of researches on the subject of radiator design and proportion, carburetor design and adjustment, ignition apparatus, and is continuing its study of the problem of an airplane engine muffler.

The committee has undertaken important investigations relating to the development of various instruments used in the navigation of aircraft and in testing aircraft in free flight. In particular there has been developed an improved form of geographic position indicator which will be of special value in connection with certain free flight tests under consideration.

Regarding the subject of aircraft communications the committee has cooperated in the development of a generator for wireless sending from airplanes and intended to satisfy the requirements of the Army and Navy. Investigations are still being carried on regarding means for detecting hostile airplanes before they are visible or before they can be heard by the unaided ear.

On March 8, 1917, the committee took under consideration the development of methods for mapping from airplanes which should be rapid, economical, and sufficiently accurate for aviation purposes. Allotments were made for developing a new type of airplane mapping camera and gratifying progress has been made in the development of such an instrument.

Soon after the declaration of hostilities with Germany, the Chief Signal Officer called to the attention of the committee the large amount of material which was coming before the War Department comprising inventions and suggestions relating to aeronautics in warfare, and asked assistance in examining and disposing of such material. Accordingly, this committee, through an appropriate subcommittee appointed for the purpose, has acted as a board of inventions for the government in matters relating to aeronautics, and since the outbreak of hostilities between the United States and Germany it has weekly examined hundreds of suggestions and inventions pertaining to this subject. Several suggestions of value have been received and brought promptly to the attention of the particular government office most directly interested.

In December, 1916, the subject of cooperation with the Post Office Department in the establishment of aerial mail routes was considered, and the same matter in one form or another has been considered from time to time since that date.

In the latter part of 1917 the general subject of civil aerial transport was brought to the attention of the committee and a special subcommittee was appointed to take under consideration the various phases of civil and commercial uses of aeronautics with special reference to the conditions which may be expected to develop at the close of the war.

The committee has made progress during the year in the study and investigation of the following problems: Stability as determined by mathematical investigation, air-speed meters, wing sections, aeronautical engine design, radiator design, air-propeller design and efficiency, forms of airplane, radio telegraphy, noncorrosive materials, flat and cambered surfaces, terminal connections, characteristics of constructive materials, and standardization of specifications for materials.

NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE fifteenth annual geological excursion of the New England colleges and universities was held on Friday, October 12, and Saturday, October 13, under the leadership of Professor J. B. Woodworth, of Harvard University, and Dr. Edward Wigglesworth, of the Boston Society of Natural History. Owing to the unusual conditions universally prevailing this year, the only colleges represented, aside from Harvard, were Mount Holyoke and Williams.

The excursion consisted of a trip to the island of Marthas Vineyard, including on the way a hurried visit to the white cedar "submerged" bog north of Woods Hole, where the question of coastal movements was discussed. On Friday afternoon, automobiles conveyed the party over the outwash glacial plain to the Weyquobsque cliffs, where the succession of the Cretaceous clays and the Miocene and Pleistocene sands and gravels was studied, as well as the rapid work of the waves in cutting back the cliffs. Spits and bars, built by the alongshore currents, were well seen from the uplands.

Saturday morning was spent at the Gay Head cliffs, studying the section of clays, sands, and boulder beds ranging from the Cretaceous to the Pleistocene, complicated by faulting and the crumpling and overthrust folding of the clays and gravels under the overriding ice of the Glacial Period. The afternoon was spent studying the so-called "morainal topography" to the northeast of Gay Head, a topography most of whose features seem to be due, primarily, to erosion during Vineyard interglacial time, deposits of Wisconsin age forming only a thin veneer on the surface of the preexisting land-forms, and carrying with them, in places, many large boulders.

In recording the appreciation of the members of the party of the care taken by the leaders to make every feature of the trip, even including the weather, a great success, the opening words of the announcement sent out before the excursion may well be repeated, "Motto: 'Go (with them) and see!'"

MEDICAL WORK OF THE UNIVERSITY OF CINCINNATI

ON the first of January a new charter went into effect in Cincinnati, which places all of the medical, scientific and nursing work in

the new city hospital under the direction of the University of Cincinnati. The charter provides that the medical director of each department shall be the professor in the corresponding department of the medical college and that the board constituted of these directors shall nominate to the board, through the president, all members of the staff of the hosiptal, including the superintendent, who shall be the general executive and business manager of the hospital. This superintendent will select all the other employees under the rules of the Civil Service Commission of the city. The charter thus removes the hospital entirely from the sphere of politics, places all the medical, scientific and nursing work under the direction of the medical college, and secures all the facilities of the hospital for the purposes of education and research. The plans for the hospital were made by Dr. Christian R. Holmes, dean of the medical faculty, and the whole building scheme has been worked out to conform to these plans.

The new building of the medical college, situated upon a twelve-acre lot immediately across the street from the hospital, has just been completed and occupied. This gives Cincinnati a complete medical teaching and research plant, costing over $5,000,000. The medical college is a regular department of the university, which pays all its expenses. The city will continue to pay the general operating expenses of the hospital, such as the heating and lighting, food, engineers, janitors, etc., while the university will pay all the expenses of the medical, surgical, scientific and nursing service. The total expenses to the city of operating the combined medical college and hospital plant will be, not including income on endowments, approximately $700,000 a year.

The same charter provides for a reorganization of the board of directors of the university, who will now be appointed, one each year, to serve for nine years. The newly elected mayor has just announced the reappointment of the former board, which has managed the affairs of the university so successfully in recent times. Its members are: Judge R. B. Smith, chairman, Mr. O. J. Renner, Dr. D. I. Wolfstein, Mr. Stanford Brown, Dr. W. R. Griess, Mr. Robert W. Hochstetter, Mr. A. R. Morgan, Mr. Emil Pollak, and Dr. E. O. Straehley. This is the second time that the members of the board have been reappointed, much to the gratification of the friends of the university. For the reappointment of faithful and experienced men gives a stability to the institution and creates a confidence in the administration which is bearing fine fruits in gifts of endowment. The Baldwin estate, amounting to over $800,000, will be turned over to the university this month.

DESTRUCTION BY FIRE OF SCIENTIFIC LABORATORIES

Mount Holyoke College lost by fire on December 22 Lyman Williston Hall, the oldest of its science laboratories. The building housed the departments of botany, geology, psychology, physiology and zoology. The loss to the college is practically complete and is estimated at more than $100,000. It includes the museums of botany, zoology and geology, the last especially rich in the dinosaur footprints of the Connecticut Valley and the laboratory equipments and libraries of all the departments mentioned. In several instances members of the faculty lost their entire private collections and working libraries as well as the results of prolonged research work. Plans are already begun for temporary quarters and such material and equipment as can be replaced will be secured as fast as possible, so that even at this season of difficult purchase the college work in the sciences concerned may go on without serious interference. If other institutions or private individuals have duplicate museum material, microscopic slides which they do not need, extra laboratory equipment difficult to procure at this time, or duplicates of out-of-print books, the heads of the various departments will be glad to learn of this in order to arrange for loan or purchase. In particular, those who have sent reprints to Mount Holyoke before may be helpful by repeating their courtesy, if possible, since much time will be needed to replace files of periodicals. Dr. Cornelia M. Clapp, for many years head of the department of zoology and physiology,

had deposited her large collection of reprints in the department library now completely destroyed. Those to whom correspondence should be addressed are Alma G. Stokey, botany department; Mignon Talbot, geology department; Samuel P. Hayes, psychology department; Abby H. Turner, physiology department; Ann H. Morgan, zoology department, Mount Holyoke College, South Hadley, Massachusetts.

The main laboratory of the United States Fisheries Biological Station at Fairport, Iowa, was destroyed by fire in the early morning of December 20, only the office furniture and records being saved.

That station is the center of most of the scientific work of the Bureau of Fisheries in the Mississippi Basin, combining the functions of mussel propagation and fishery investigation and experimental work. It is the only station of the bureau equipped and employed for continuous fish-cultural experiment work. Fortunately, the water supply, the large series of ponds, and the smaller buildings are unharmed, and many phases of the work will continue without interruption. Nevertheless, the loss of the laboratory, with its excellent equipment for biological and chemical studies, will serve to retard some investigations of immediate importance to the best utilization of the products of fresh waters.

Not the least significant loss was the library which, though not large, had been assembled with much care. It comprised many rare books and a large number of separate pamphlets contributed by authors or gleaned from the second-hand book stores of America and Europe. Many of these can not be replaced.

As steps are now being taken looking to the prompt restoration of all facilities for investigation, the cooperation of authors is particularly invited. Those having separates relating to the subjects of fresh-water biology, ecology, limnology, biochemistry and the chemistry of foods will render a valuable service by forwarding papers to the station or the Commissioner of Fisheries, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

The officers elected at the Pittsburgh meeting of the American Association for the Advancement of Science are given in the account of the meeting published elsewhere in the present issue of Science. Professor John M. Coulter, of the University of Chicago, the newly elected president of the association, was also elected president of the American Association of University Professors.

Professor Wilder D. Bancroft, of the department of chemistry of Cornell University, is in Washington, serving as technical adviser in the U. S. Bureau of Mines.

Assistant Professor P. W. Bridgman has received leave of absence from Harvard University to join Professor G. W. Pierce at the submarine base in New London, where both will experiment on wireless problems.

Dr. Bashford Dean, of the American Museum of Natural History, has been assigned the rank of major in the United States Army and is at present in Europe.

Dr. Thomas Darlington, formerly health commissioner of the city of New York, has been called to Halifax by the relief committee to act in an advisory capacity regarding the sanitation and housing in the reconstruction of the devastated areas.

In recognition of his contributions to science, Colonel Theodore Roosevelt has been appointed honorary fellow of the American Museum of Natural History, of which his father, Theodore Roosevelt, Sr., was one of the founders and most energetic supporters.

The Société de Pathologie Exotique, of Paris, has elected Charles A. Kofoid, professor of zoology, University of California, as corresponding member.

At its fifth annual meeting in New York on January 18 the National Institute on Social Science will present medals for "notable service to mankind" to Herbert C. Hoover, Food Administrator; Henry P. Davison, chairman of the Red Cross War Council, and Dr. William J. Mayo, the surgeon.

On the recommendation of Surgeon-General Bradley, General Pershing has appointed a

committee to study hospital conditions, surgical treatment and sanitary medicine in Italy. The committee consisted of the following members: Majors Angus McLean, George E. McKean and Harry N. Torrey. Lieutenant Bror H. Larsson accompanies the expedition as secretary, and Captain James W. Inches represents the American Red Cross. Permission for this investigation was obtained through the Italian military authorities, and was granted for fourteen days.

Dr. Joel Asaph Allen, after twenty-eight years of active service as editor of the scientific publications of the American Museum of Natural History, has resigned in order to devote his entire time to the collections of the department of mammalogy and ornithology, of which he is curator. The following is an extract from the resolution passed by the publication committee of the museum in appreciation of Dr. Allen's services:

> . . . As the scientific editor, he has been little less than ideal, since with a natural fitness for the calling there was combined also the highest quality of scholarship in the subjects dealt with by his contributors. He was thus more than editor; rather a leader in the researches represented in the *Bulletin* and *Memoir* series.

Dr. F. E. Lutz, of the department of invertebrate zoology has been appointed to suceed Dr. Allen.

At the recent meeting of the American Association of Anatomists, held in the new Institute of Anatomy at the University of Minnesota, Minneapolis, the following officers were elected: *President,* Professor R. R. Bensley, of the University of Chicago; *Vice-president,* Professor C. R. Bardeen, of the University of Wisconsin; *Secretary-Treasurer,* Professor C. R. Stockard, of Cornell University; *Members of the Executive Committee,* Dr. G. L. Streeter, Carnegie Institution, Professor G. S. Huntington, Columbia University, and Professor H. E. Jordan, University of Virginia.

The following officers have been elected by the Association of American Geographers for 1918: *President,* Nevin M. Fenneman; *First Vice-President,* Charles R. Dryer; *Second Vice-President,* Bailey Willis; *Secretary,* Oliver L. Fassig; *Councilor,* Walter S. Tower; *Treasurer,* François E. Matthes.

The British Air Inventions Committee appointed by Lord Cowdray, the late president of the Air Board, consists of the following members: Mr. Horace Darwin, F.R.S., chairman, Major-General Luck, vice-chairman, Sir Dugald Clerk, F.R.S., Sir Richard Glazebrook, F.R.S., Professor H. L. Callendar, F.R.S., Professor C. H. Lees, F.R.S., Professor J. E. Petavel, F.R.S., Mr. L. Bairstow, F.R.S., Lieutenant-Commander Wimperis, Major G. Taylor, Captain B. M. Jones, Captain A. V. Hill, Munitions Inventions Department, Mr. J. P. Millington and Mr. F. W. Lanchester. The main function of the committee is to investigate inventions submitted to it.

The next lecture of the Harvey Society will be given on Saturday evening, January 12, at the New York Academy of Medicine, on "Food Chemistry in the Service of Human Nutrition," by Dr. H. C. Sherman, professor of food chemistry in Columbia University.

At University College, on December 18, Major Sir Filippo de Filippi delivered a public lecture, illustrated by lantern slides, on the sanitary services of the Italian army.

At the meeting of the Royal Statistical Society on December 18, Sir R. Henry Rew read a paper on the prospects of the world's food supplies after the war.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Zenas Crane, late of Dalton, Mass., public bequests of more than $500,000 are made to various institutions, including $200,000 to the Berkshire Museum of Natural History and Art of Pittsfield; and $5,000 each to Washburn College, Topeka, Kans.; Yankton College, Yankton, S. D.; Idaho Industrial Institute, Weiser, Idaho; Lincoln Memorial University, Cumberland Gap, Tenn.; Oberlin College, Oberlin, Ohio; Berea College, Berea, Ky.; Tuskegee Normal School, Tuskegee, Ala.; Hampton Normal and Industrial School, Hampton, Va.

UNDER the will of Evelyn MacCurdy Salisbury, of New Haven, widow of the late Professor Edward E. Salisbury, Yale University is to receive the sum of fifty thousand dollars to found a professorship to be called the Charles J. MacCurdy professorship of anthropology, on condition that the university pay to George Grant MacCurdy the sum of twenty-five hundred dollars annually during his lifetime. The will also provides for a conditional annual gift of fifteen hundred dollars to be expended at the discretion of Professor MacCurdy for the benefit of the anthropological department of the Yale Museum. Another provision is that upon the decease of George Grant MacCurdy the sum of sixty thousand dollars is to be paid to either (1) Yale University to found a research fund to be called the Evelyn MacCurdy Salisbury Research Fund in Anthropology; or (2) the Connecticut College for Women at New London to found a professorship of American history as George Grant MacCurdy shall designate by his last will; a power of apportionment as between these two institutions being conferred upon him.

MRS. KING, of Worthing, has given £1,000 five per cent. war stock for the establishment in the University of Cambridge of a scholarship for research work on fevers, in memory of her daughter, Neita King, a member of a voluntary aid detachment who died of cerebrospinal fever in France last May.

THE Harvard University registration is 3,684, nearly 2,000 less than last year. The Law School shows the greatest decrease, its figures of 856 last year dropping to 296 this year. Two departments show an increased attendance, the Medical School, with an enrolment of 386, a gain of 28 over last year, and the engineering and mining department, with 591, an increase of 14.

WILLIAM M. DAVIS, Sturgis Hooper professor of geology, emeritus at Harvard University, has asked to be relieved of his position as western exchange professor, and his resignation has been accepted.

CHARLES FULLER BAKER, assistant director of the Botanic Gardens at Singapore, and professor of agronomy (on leave) at the College of Agriculture of the Philippines, has been recalled to the Philippines to assume the deanship of the College of Agriculture and the professorship of tropical agronomy due to the mid-year retirement of Dean Copeland.

DISCUSSION AND CORRESPONDENCE

GEOLOGIC DATES IN PHYSIOGRAPHIC DESCRIPTIONS

THE protest repeatedly urged by Davis[1] against the unwarranted introduction of formation names and other irrelevant geologic material into geographic descriptions is, no doubt, heartily seconded by the majority of geographers and physiographers.

A good thing may, however, be carried too far.

A case in point, as it appears to the writer, is a description by C. A. Cotton of "Block Mountains in New Zealand," which appeared in a recent number of the *American Journal of Science*.[2]

Cotton's paper is a most commendable example of a physiographic description worked out along the lines advocated by Davis. The material is most effectively presented, but, in accordance with Davis's suggestions, all mention of geologic age, or dates, either of the block faulting movements or of the formations involved, is deliberately and studiously avoided.

This may be desirable from the standpoint of a geographer whose sole interest is in the present landscape, but his geological colleagues are sure to find it disappointing.

The science of geomorphology has now reached such a stage that it has an interpretative as well as a descriptive value. Geologists are coming more and more to rely upon physiographic evidence in interpreting recent earth history. Why, then, should a

[1] Annals Assn. Amer. Geogr., Vol. V., 1915, p. 90.

[2] Cotton, C. A., "Block Mountains in New Zealand," *Am. Jour. Sci.*, 4th Ser., Vol. XLIV., 1917, pp. 249–293.

physiographic contribution of so great possible interpretative value as "Block Mountains in New Zealand" be rendered almost useless to the student of earth history by the deliberate omission of all reference to geologic dates? Surely the incidental mention of the geologic age of the weak over-mass described by Cotton, and of any other events whose geologic dating may have been known, would not have impaired the geographic value of the paper.

By all means let us eliminate unnecessary and irrelevant geologic detail from geographic or physiographic descriptions, but let us not go to the extreme of rendering our geomorphologic studies valueless for their important interpretative functions.

John L. Rich

University of Illinois

REMOVING INSECTS FROM GREENHOUSE PLANTS WITHOUT SPRAYING AND WITHOUT INJURY TO THE PLANTS

When one is running experiments in the greenhouse and the plants become infested with insects, the disposal of the pests becomes an important question. This question becomes all the more important if the nature of the investigation will not permit the plants to be sprayed. The writers were recently faced with such a problem and solved it by using an apparatus working on the principle of a vacuum cleaner.

A flask was fitted with connections similar to those of a wash bottle, the mouthpiece being connected with a suction pump by a piece of tubing sufficiently long to allow the flask to be moved to any point desired. The nozzle was extended to a point parallel with the bottom of the flask and the opening made sufficiently small to just allow the desired insects to pass readily. By putting a small amount of oil in the flask, for an insecticide, closing the connections and turning on the pump, the apparatus was ready for use. Small plants that were thickly covered with aphids and red spiders were quickly cleaned. Ants and other insects were also readily taken up. It is possible that this apparatus may be modified to meet many requirements by simply changing the size and shape of the nozzle, and by using various kinds of motors and pumps.

Paul Emerson,
J. B. S. Norton

Maryland Agricultural Experiment Station,
College Park, Md.

SCIENTIFIC BOOKS

The Electron, Its Isolation and Measurement and the Determination of Some of Its Properties. By R. A. Millikan. University of Chicago Press.

This volume of 260 pages contains an account of the work on the exact determination of the electronic charge and allied subjects done by Professor Millikan and his pupils during the last ten years. It also contains an account of the earlier researches which led up to Millikan's work, and besides a short discussion of recent views on the electron theory of matter and the theory of radiation to which Millikan's exact investigations have added precision in several important ways.

The book is intended for the general reader as well as for the physicist and it will be read by both with immense enjoyment and instruction. It is written clearly and concisely and is full of most interesting and important information.

The only criticsm the writer of this review has to make is that the concluding chapters are too short; they contain so much that is interesting and suggestive that one can not help wishing the writer had found time to make them as full of detail as some of the earlier chapters.

Millikan's beautiful investigations on the electronic charge and on the photo-electric effect are justly celebrated throughout the scientific world; they will undoubtedly become classical examples of the highest type of modern physical research. A description of such researches by their author is immensely valuable and will serve to stimulate scientific investigation as nothing else can.

Every student of physics, and especially every graduate student, should obtain this book and study it thoroughly and then en-

deavor to imitate the author's infinite capacity for taking pains to overcome every difficulty and eliminate every source of error. By such work modern science is placed on a sure foundation, and besides new avenues of research are opened up. It is a mistake to suppose that investigations of high precision do not lead to new discoveries. Lord Rayleigh's exact measurements of the densities of the common gases resulted in the discovery of argon, and many similar examples could be given. It would be truer to say that inexact work often leads to discoveries being missed which ought to have been made and besides rough work generally leads to erroneous conclusions which others have to waste valuable time and energy setting right. Millikan, for example, has had to spend considerable time setting right the erroneous conclusions of Ehrenhaft on the existence of a "sub-electron," conclusions which ought never to have been drawn.

Millikan's new book is admirably printed and illustrated and seems very free from typographical errors. It is dedicated to Michelson and Ryerson and forms a record of work worthy of the inspiration of the former and the generosity of the latter. H. A. W.

MINERALS OF JAPAN

VALUABLE service has been rendered to mineralogy by Dr. Wada in his editorship of the "Beiträge zur Mineralogie von Japan," the articles in which, in spite of the German title, have been almost all in English. The latest issue[1] contains two articles on the minerals of Korea by Nobuyo Fukuchi, describing specimens of sixty different minerals (pp. 207–228). Other papers treat of prismatic sulphur from Formosa, by Masakichi Suzuki; the optical properties of danburite from Bungo Province, Japan, by Mikio Kawamura; epidote crystals from Iwaki Province, by Kinzô Nakashima; ferberite from Kai Province and hübnerite from Shimotsuke Providence, by Kotora Jimbô. A paper of special interest is that on the aragonite cones formed at the Kurujama Geysers, in Yuzawa, Shimotsuke Province, Japan. A cone 30 cm. in height was formed by the hot water of one of the geysers in a period of ten months.

In his work on "The Minerals of Japan," Dr. Tsunashirô Wada[2] gives in concise and systematic form characterizations of the various mineral forms that had been observed in Japan up to the date of his treatise. His thorough training in European methods added to his familiarity with the geology of his native land make this book a trustworthy source of information. The crystallographic details are quite fully given and constitute one of the most valuable features of the work for the mineralogical student.

As to the metals of Japan, Dr. Wada notes that the richest gold deposits are those on the island of Formosa (p. 12), the chief localities being Zucho Kinkwaseki near Taihoku, in the northeastern part of the island. Quartz veins traversing a volcanic rock are sometimes found bearing a large quantity of native gold. Frequently the yellow surface has a coating of limonite formed by the decomposition of pyrites. There are also alluvial gold deposits in Formosa. In Japan proper the rich placers in the Hokkaido are extensively worked; one crystal from the mining district of Esashi measured 6–10 mm. along the edges of its octahedron. The largest nugget was found in 1900 at the Usotannai in Esashi; it weighed 769.2 grams (2 pounds 15 2/3 dwts. Troy), the dimensions being $106 \times 63 \times 25$ mm. (p. 13) and the intrinsic value about $500. The oldest known gold mine in Japan is that of Sado.

As in many parts of the world, platinum is found in association with gold in Japan, for example in the Yubari-gawa and Pechan rivers in the Hokkaido, and it occurs with gold and iron sands in Nishi-Mikawa. Copper and silver are also met with in a number of localities, but crystallized silver has never been found in Japan.

Of the ornamental or gem stones the ame-

[1] "Beiträge zur Mineralogie von Japan," ed. by T. Wada, No. 5, November, Tôkyô, 1915 (pp. 207–305 of the series, one plate).

[2] Tsunashirô Wada, "Minerals of Japan," transl. by Takudzi Ogawa, Tôkyô, 1904, vii + 144 pp., 30 pls., 8vo.

thyst of Fujiya, Hoki Province, must be noted, and rose quartz is found at Gota. Maki Province (pp. 46, 47). Inclusions of quartz come chiefly from Mukaiyama and Takemori, the green fibrous inclusions being epidote and the brown fibrous ones tourmaline; included sulphur of a beautiful yellow is limited to quartz of Takemori. Fluid inclusions are quite common, being usually distributed irregularly throughout the crystal, though sometimes in definite layers parallel to the faces of the rhombohedron (p. 44). Felspar, tourmaline and garnet are here found in association with quartz. Localities well known since ancient times for beautiful quartz crystals are the granitic regions around Kimpû-zan, Kai Province. Here colorless and transparent crystals for ornamental work have been obtained for centuries (p. 38). It is well known that the manufacture of beautiful crystal balls has long been carried on in Japan.

A small crystal of crysoberyl has been found in stanniferous sand of Takayama, Mino Province; it was of a pale greenish-yellow color (p. 82). Beautiful crystals of vivianite were at one time met with at Ashio, Shimotsuke Province. At first they were light blue, but became darker on exposure to the air (p. 86). Some blue, transparent crystals of tourmaline have been found at Takayama, Mino Province, and beryl found here resembles the tourmaline in color and form, one end of the crystal being of a lighter hue, while the other end is decidedly darker and only semi-transparent. The topaz, however, is the most conspicuous of the gems found in Japan and Dr. Wada gives a very full account both of the occurrences and of the crystallographic forms (pp. 89–113). It occurs in pegmatite veins in granite as in Takayama and Hosokute, Mino Province, Ishigure, Ise Province, and Tanokamiyama, Omi Province. Japanese topazes were first exhibited in the National Exposition of Tokio in 1877. Six different hues have been observed, as follows: (1) Colorless; (2) wine-yellow, or bluish-yellow; (3) pale blue; (4) pale brown and pale blue in sectors; (5) pale green; (6) brown. On exposure to daylight the brown and brownish-yellow shade into blue, and the blue tends to become colorless. The brown hue is confined to a few freshly-quarried specimens, and is never observable in those which have been kept long in daylight. In some specimens the structure is shown by inclusions arranged parallel to the outline of the crystals, producing the strange effect observable in the so-called "phantom quartz."

The most beautiful of the topaz crystals illustrated by Dr. Wada (Plate XXIV., Fig. *a*) was found between 1870 and 1880. It came later into the possession of Count K. Inowe who presented it to Dr. Wada. It measures 84 mm. in length, 64 mm. in the longer diameter and 51 mm. in the shorter. It is based on a piece of felspar, and on the side is black quartz crystal, the topaz standing nearly perpendicular to its prismatic faces.

Geo. F. Kunz

New York City

SPECIAL ARTICLES

THE GEOMETRICAL MEAN AS A B. COLI INDEX

Several reasonable objections have dissatisfied bacteriologists with the present methods of estimating the average number of *B. coli* in water.[1] The following method is proposed as a simple, convenient, and theoretically desirable means of arriving at a numerical index representing such a series of results. It was suggested in 1912 by data obtained at the Washington Filter Plant,[2] and has since been practically applied with much success.

Data—*B. coli* are determined to be present or absent in a series of fermentation tubes containing portions of the sample in multiples of ten, *i. e.*, 10 c.c., 1 c.c., .1 c.c., .01 c.c., .001c.c., etc.

Example: Suppose twenty samples or series of tubes gave the following results, where + or positive means *B. coli* were found present,

[1] Report of the Committee on Standard Methods, American Public Health Association, 1916.

[2] Wells, W. F., "Some Notes on the Use of Alum in Connection with Slow Sand Filtration at Washington, D. C.," Proceedings of American Water Works Association, 1913.

and conversely—or negative means *B. coli* were not found.

10 C.c.	1 C.c.	.1 C.c.	.01 C.c.	.001 C.c.
20+ 0−	18+ 2−	8+ 12−	1+ 19−	0+ 20−

Problem.—The problem is to derive from a number of such determinations a numerical index of the most probable result to be obtained by repetition.

Definition.—Call the quantities used "Dilutions," since the dilution method is the one used for measuring those quantities. Specifically grade the dilutions as follows:

Quantity..	10 c.c.	1 c.c.	.1 c.c.	.01 c.c.	.001 c.c.,	etc.
Dilution ...	0	1	2	3	4	, etc.

Call the "Dilution Positive" that "Dilution" at which higher "Dilutions" were negative and lower positive, after reverting skips where such occur.

Example continued:

"Dilution	0	1	2	3	4
Positive" ...	2	10	7	1	0

Average Dilution Positive.—Add the "Dilutions Positive," and divide by the number of samples to find the "Average Dilution Positive."

Example continued:

"Dilution Positive"

$$
\begin{array}{rl}
0 \times 2 = & 0 \\
1 \times 10 = & 10 \\
2 \times 7 = & 14 \\
3 \times 1 = & 3 \\
4 \times 0 = & 0 \\
\text{Total } 20\ ) & 27 \\
\text{Average} & 1.35
\end{array}
$$

Score.—The decimal part of the "Average Dilution Positive" gives the "Score," and the integral part tells how many figures to point off. The reason for calling it a "Score" is that it is directly comparable to the bacteriological score of oysters.[1] In the above example, the "Score" would be 3.5. For all ordinary purposes, the "Score" is a very good index and can be used directly.

Geometrical Mean.—The "Score" can be converted into the "Geometrical Mean" from the following table:

TABLE FOR CONVERTING SCORE INTO GEOMETRICAL MEAN

	0	1	2	3	4	5	6	7	8	9
0	100	102	105	107	110	112	115	118	120	123
1	126	129	132	135	138	141	145	148	151	155
2	159	162	166	170	174	178	182	186	191	195
3	200	205	209	214	219	224	229	235	240	246
4	251	257	263	269	276	282	289	295	302	309
5	317	324	331	339	347	355	363	372	381	389
6	398	407	417	427	437	447	457	468	479	490
7	501	513	525	537	550	562	576	589	603	617
8	631	646	661	676	692	709	725	741	759	776
9	794	813	832	851	871	891	912	933	955	977

From the previous example, the "Score" 3.5 becomes "Geometrical Mean" 2. 24, which is not very different. Either represents an approximation sufficiently close to be considered the number of *B. coli* per c.c.

Percentage Method.—The same results are given by an alternative method, which may sometimes be more convenient. Compute the percentages that are positive in each "Dilution." The resulting figures should extend from a "Dilution" at which 100 per cent. are positive to one at which 100 per cent. are negative. The percentages are then added, and will give a number of three figures before the decimal point. The first or hundreds figure is discarded, the other figures giving the "Score" when properly pointed off by inspection.

Example continued:

Quantity		Per Cent. +
10	c.c.	100
1	c.c.	90
.1	c.c.	40
.01	c.c.	5
.001	c.c.	0
		235

Discarding the 2 gives the "Score" figures of 35. Inspection shows there are more than .35 and less than 35, and thus the same result, 3.5, is obtained as by the previous method.

Reversion Method. (*a*) *Direct.*—The principle of reversion used in figuring the oyster score[1] may also be applied in this method.

Example continued: The + .01 c.c. tube and one of the + .1 c.c. tubes revert to the 1 c.c. column, leaving seven + .1 c.c. tubes out of twenty samples. This gives 35 per cent. of the .1 c.c. tubes positive or as before the "Score" 3.5 when pointed off.

(*b*) *Percentage.* The same thing may be done from the percentage column above, *i. e.*, 5 per cent. of the .01 c.c. and 5 per cent. of the .1 c.c. tubes revert to make the 90 per cent. of the 1 c.c. tubes up to 100 per cent., leaving 35 per cent. of the .1 c.c. tubes positive as before.

Single Dilution Method.—Frequently determinations are made in one dilution only. In this case the "Percentage Positive" gives the "Score" as where several are used.

Split Dilutions.—Where other "Dilutions" are used than the regular ones, the same methods can be applied by using the corresponding "Dilution" in the computation.

CONCLUSION ARGUMENT

The reason the above simple methods give the "Geometrical Mean" arises from the fact that the ordinary bacteriological dilution scale is in reality a logarithmic scale, and the average dilution is the average logarithm or the logarithm of the "Geometrical Mean." A vast amount of published bacteriological data to be considered at some other time proves that bacteriological results follow a logarithmic probability curve, from which it follows that the median value closely corresponds to the geometrical mean. It is equally probable, therefore that another sample would be greater as less than the geometrical mean. There is nothing in this principle to limit the application of the method, and by intelligent application it can be employed in interpreting all similar forms of data.

William Firth Wells

Field Laboratory,
Milford, Conn.

PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The seventieth meeting of the American Association for the Advancement of Science was held in Pittsburgh, Pennsylvania, on December 28, 1917, to January 3, 1918. It seems to be a very general opinion of the members who attended that the meeting was practically an unqualified success. The total registration at the office of the permanent secretary was 692.

It is impossible to estimate the number of members who were deterred from attendance by the statement sent to the press by the Pennsylvania Railroad late in December, and by the published letter of Dr. Richards, but it is obvious that no congestion of traffic, and no clogging of trains resulted from the meeting. Of the 692 persons registered, 194 came from Pittsburgh and other parts of Pennsylvania, 122 registering from Pittsburgh alone. The remaining attendance came as usual from all points of the compass, and were distributed on the regular trains arriving at different times, so that their train presence was scarcely to be noticed.

The attendance was distributed as follows: from Pittsburgh and the rest of Pennsylvania, as just stated, 194, New York 84, Ohio 59, District of Columbia 44, Illinois 34, Massachusetts 26, West Virginia 21, Indiana 20, Michigan 18, Wisconsin 15, Maryland, Missouri and Canada 14 each, Iowa and Texas 13 each, New Jersey and Virginia 11 each, California 10, North Carolina 8, Connecticut, Tennessee and Kansas 6 each, Minnesota and Arizona 5 each, New Hampshire, Louisiana and Montana 4 each, Maine, Delaware and Kentucky 3 each, Japan, Nebraska, Utah, Oregon and Colorado 2 each, Rhode Island, Georgia, North Dakota, Arkansas and Wyoming 1 each.

The interest of the meeting was enhanced by the presence of the following foreigners, who were made honorary associates for the meeting: Lieutenant Georgia Abbetti, of the Italian Military Commission; Lieutenant G. P. Thompson, of the Royal Flying Corps of Great Britain; Captain De-Guiche, of the French Military Commission, and Dr. Shigetaro Kawasaki, chief geologist of Korea.

The impressive keynote of the whole meeting was war preparation and efficiency. This was borne out not only in a number of symposia devoted to specific war topics, but also in other discussions, and in other papers, the titles of which would not necessarily lead one to expect a development along the line of war preparation. The local press was keen in noticing this aspect of the meeting, and paid great attention to the papers of the entire session.

The opening general session of the association was held Friday night, December 28, in the lecture hall of the Carnegie Institution. The president of the Association, Professor Theodore W. Richards, of Harvard University, was absent, and Dr. George H. Perkins, of the University of Vermont, senior vice-president, presided. Mr. H. M. Irons, city at-

torney of Pittsburgh, gave an address of welcome on behalf of the mayor of Pittsburgh, to which Dr. Perkins replied.

The permanent secretary, under instructions from the council, proposed the following amendments to the constitution, which were adopted unanimously:

1. To amend Article 22 of the constitution by omitting after the word "*chemistry*" in the second line, the words "*including its application to agriculture and the arts.*" The article as amended will read:

Sections and Sub-sections

Art. 22. The Association shall be divided into sections, viz: A—Mathematics and Astronomy; B—Physics; C—Chemistry; D—Engineering; E—Geology and Geography; F—Zoology; G—," etc.

2. To amend Article 9 of the constitution by adding in line 8, after the words "*Permanent Secretary*" the words "*and the secretaries of the Sections.*"

(*Note.*—The effect of the above will be to make secretaries eligible for reelection.) The Article as amended will then read:

"*Art. 9.* The officers of the association shall be elected by balloting by the General Committee from the fellows and shall consist of a president, a vice-president from each section, a permanent secretary, a treasurer, and a secretary from each section; that is, with the exception of the permanent secretary, the treasurer and the secretaries of the sections, shall be elected at each meeting for the following one and, with the exception of the treasurer and the permanent secretary *and the secretaries of the sections,* shall not be reelected for the next two meetings. The term of office of the permanent secretary and of the treasurer and of the secretaries of the sections shall be five years."

Dr. W. J. Holland, chairman of the local committee, made certain announcements, after which Dr. C. R. Van Hise, retiring president of the association, gave his address, which had for its title "Some Economic Aspects of the World War," and in this able and strong address President Van Hise set the note for the entire meeting.

This was followed by a reception in the foyer of the Carnegie Institution by the members of the local committee and their wives.

Certain special items on the program of the week may be especially mentioned on account of their war bearing.

Section C held a symposium on "Education in Chemical Engineering."

Section M held an important symposium on "Factors concerned in an Increased Agricultural Production."

Section I listened to a paper by Hon. John Barrett on "The War and the New Pan-America," and before this same section, Howard E. Coffin, president of the Aircraft Board at Washington, spoke on the subject of "General Standardization."

Section B held a general interest session on the subject of "Relationship of Physics to the War."

Section G with the Botanical Society of America and the American Phytopathological Society, held a joint session on "War Problems in Botany."

Dr. Vernon L. Kellogg, formerly of the Belgium Relief Commission, and now with Mr. Hoover's board in Washington, gave an exceedingly strong address before the Entomological Society of America on "The Biological Aspects of the War."

Section I held a special symposium on "War Problems."

Section F held a symposium on "Contributions of Zoology to Human Welfare," in which many war problems were discussed.

Section K held a very important symposium which was packed to the doors, on the subject of "Medical Problems of the War." This symposium included an address by Lieutenant George Loewy, of the French Army, on "The Treatment of War Wounds by the Carrel Method," which was illustrated by moving pictures.

The School Garden Association of America held a symposium on "Organization of War Gardens."

The Association of Economic Entomologists discussed the two following topics at length: "Insects and Camp Sanitation," and "How the Entomologist can assist in increasing Food Production."

The Botanical Society of America, and the American Phytopathological Society held a symposium on "Phytopathology in relation to War Service."

Many of these papers will be published in subsequent issues of this journal, and abstracts of many more will also appear.

The affiliated societies meeting with the association at Pittsburgh were as follows: American Federation of Teachers of Mathematical and Natural Sciences, American Physical Society, Optical Society of America, American Electrochemical Society, Society for the Promotion of Engineering Education, Paleontological Society of America, American Society of Naturalists, Entomological Society of America, American Association of Economic Entomologists, Ecological Society of America, Wilson Ornithological Club, Botanical Society of America, American Phytopathological Society, American Society for Horticultural Science, American Fern Society, American Microscopical Society, American Psychological Association, American Metric Association, American Nature Study

Society, The School Garden Association of America, Society of American Foresters, Society of the Sigma Xi, Gamma Alpha Graduate Scientific Fraternity, Phi Kappa Phi Fraternity.

The local arrangements for the meeting had been made in a very efficient manner by the local committee, of which Dr. W. J. Holland, of the Carnegie Museum, was chairman, and Dr. S. B. Linhart, of the University of Pittsburgh, was secretary. All the meetings were held in the buildings of the University of Pittsburgh, The Carnegie Institute of Technology and the Carnegie Institute.

The council of the association took action as follows:

1. *Resolved* that the revision of the constitution be not pushed at this time—a report published.

2. *Resolved* that the dues of those members in active service in the army and navy be remitted for the period of the war when the member in question makes specific request in his own case.

3. *Resolved* that the editorial control of the journal SCIENCE be placed in the charge of an editorial committee to be named by the committee on policy.

4. *Resolved* that the necessary arrangements can be made at the Post Office Department so that the journal may be sent to the front in Europe by members who desire to do so.

5. Messrs. H. B. Ward, H. C. Cowles and Stewart Paton were elected members of the council.

6. The following were made life members emeritus under the terms of the Jane M. Smith Fund: C. H. Fernald, R. H. Richards, Marshall Calkins and T. J. W. Burgess.

7. Two hundred and seventy-eight fellows were elected from the nominations by especially appointed representatives of the sections who have scrutinized the manuscript list at Washington.

8. *Resolved* that until the next annual meeting, all business of the association be referred to the Committee on Policy with power to act.

9. *Resolved* that the president of the association be requested to appoint a committee of five fellows to cooperate with a similar committee of the Association of University Professors, and with other similar associations in the consideration of methods for the publication in this country of bibliographies progress-reports and abstracts.

10. On motion, the council instructed the permanent secretary to carry into effect the following points at future annual meetings: (*a*) The meeting places for sections and societies having been once printed, should not be changed. (*b*) Meeting places for allied interests and societies should be placed as close together as possible. (*c*) The entire number of meeting places should be grouped as closely as possible. (*d*) Authorizing the printing of detailed advice to Local Committees for individual distribution to members of such committee.

11. Messrs. Stewart Paton, H. L. Fairchild and H. B. Ward were elected members of the committee on policy.

12. The permanent secretary was granted the authority to purchase a new electric addressograph for his office.

13. The salary of the assistant secretary, Mr. F. S. Hazard, was raised to $2,100 per annum, beginning with January 1, 1918.

14. The council endorsed the following resolution coming from Section F: "It is important that in any plans formulated or encouraged by the American Association for the Advancement of Science looking towards the organization and development of national or international bibliographic projects, the existing international bibliographic undertaking for zoology, *i. e.*, the Concilium Bibliographicum in Zurich, long approved by this association and in part supported by numerous grants from its funds, be kept definitely in mind and included in any plan for bibliographic work presented for consideration by the special committee of the council."

At the meeting of the general committee at the Schenley Hotel on the night of December 31, it was decided to hold the next meeting of the association in Boston, Massachusetts, meeting to begin on Friday, December 27, 1918. This decision was adopted with the amendment that the committee on policy be given the power to cancel the meeting, or to change the place for it should they see best to do so. On motion the general committee recommended to the general committee of 1918 that St. Louis be chosen for the place of meeting following Boston.

The following officers were elected, President, John M. Coulter, of the University of Chicago; Vice-presidents as follows:

Section A, George D. Burkhoff, Harvard University;
B, Gordon T. Hull, Dartmouth College;
C, Alexander Smith, Columbia University;
D, Ira N. Hollis, Worcester Polytechnic Institute;
E, David White, U. S. Geological Survey, Washington, D. C.;
F, Wm. Patten, Dartmouth College;
G, A. F. Blakeslee, Cold Spring Harbor;
H, (no election);
I, John Barrett, Washington;
K, Frederic S. Lee, Columbia University;
L, S. A. Courtis, Detroit, Mich.;
M, H. P. Armsby, Pennsylvania State College.

O. E. Jennings, of the Carnegie Museum, Pittsburgh, was elected general secretary for 1918. The following secretaries of sections were then elected:

Section A, F. R. Moulton, University of Chicago;
C, Arthur A. Blanchard, Massachusetts Institute of Technology;
D, F. L. Bishop, University of Pittsburgh;
F, H. V. Neal, Tufts College;
G, Mel. T. Cook, Rutgers College;
H, E. K. Strong, Jr., Washington;
L, B. T. Baldwin, Swarthmore College.

L. O. HOWARD,
Permanent Secretary

SCIENCE

Friday, January 18, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

PRESENT TENDENCIES IN THEORETICAL PHYSICS[1]

At a time like the present, when the minds of all of us are intent upon the war and the great issues which depend upon it, it seems almost an affectation to discuss before you a subject so remote from "the instant need of things" as the methods and outlook of theoretical physics. The custom of many years, however, constrains the sectional vice-president to deliver an address. The many questions raised by the war and the relation of science to war have been so thoroughly discussed that I should certainly not be justified in inflicting upon you at great length my own views. The only alternative, therefore, to an appearance of detachment, which I am far from feeling, would have been the abolition for this year of the vice-presidential address before Section B—a measure of war-economy which would have commanded my hearty and unqualified support.

When, however, we turn our minds to a consideration of the recent development of our science, we are confronted at once with the unmistakable fact that there has been little progress since August, 1914, in either theoretical or experimental physics. We had become accustomed to a steady succession, year by year, of important experimental discoveries and of ingenious and original theoretical discussions; we need mention only a few—the Stark Effect, the crystalline diffraction of X-rays, Onnes's

[1] Address of the vice-president and chairman of Section B—Physics—American Association for the Advancement of Science, Pittsburgh, December, 1917.

superconductivity, Debye's theory of specific heats, the Rutherford nucleus atom, the existence of chemical isotopes, Bohr's theory, Moseley's law, Einstein's theory of gravitation. I do not recall anything comparable with these in interest and importance which has appeared during the past three years. Whatever services science may render to war, it is plain that a state of war is not favorable to the progress of science. Accordingly, the word "present" in my title must be interpreted with some latitude; it really applies to the state of things before the peaceful labor of physicists was interrupted by the duty of turning their attention to problems in applied science whose solution is of immediate urgency.

No one can doubt that there has been something very like a revolution in the ideas and methods of theoretical physics since the beginning of the twentieth century. Much recent work of undoubted significance would seem very strange to Helmholtz and Lord Kelvin; and even in some of our own contemporaries whose tastes are conservative, it excites feelings similar to those experienced by a Royal Academician before a cubist painting. On the other hand, some of our younger and more enthusiastic colleagues are inclined to be impatient of what they call "classical" theories (some of which were perfected in the 1890's), and to regard them as examples of superstition and logical punctilio from which they have been happily freed.

The truth is of course to be found between the two extreme views. We must recognize that this is not the first change in physical science which has seemed at the time to be revolutionary. In the past, these changes have never been so complete and overwhelming as was expected by their supporters, nor so abortive as hoped by their opponents. In science, as in art, politics and religion, the radicals are always partly right and the conservatives never wholly wrong; and the interplay and conflict between the two is of the very essence of progress.

One of the most striking things about the modern beginnings of our science—the preliminary formulation of the principles of mechanics by Galileo, and their more complete development by Newton—was their almost immediate acceptance by all who were not blinded by theological prejudices. This can not have been because they were simple or easy to formulate, or the world would not have had to wait so many centuries for them. But the phenomena of mechanics are directly and explicitly presented to us from our earliest childhood, and have been so presented to our long line of ancestors, human and pre-human. Under given conditions, certain mechanical actions are almost as confidently expected (even by quite uninstructed persons) as if their knowledge was of the *a priori* character that is attributed by many philosophers to our mathematical and spatial concepts. Even animals share this mechanical knowledge. The instinctive movements of a cat, which enable it to land upon its feet, could scarcely be improved upon if it possessed a satisfactory knowledge of the conservation of angular momentum. The difficulty of formulation was doubtless due to the lack of recognition of the true character of frictional and dissipative forces, and to the obscuring of the idea of mass by the more conspicuous property of weight. At all events, when the principles are once presented to the normal, intelligent, observant mind, they are quickly recognized, and soon come to seem almost as axiomatic as the attributes of space and number. There can be little doubt of the reality of this mechanical "intuition," be its origin what it may. Whatever the philosophers

may think of it in their moments of sophisticated philosophizing, there can be no doubt that they, in common with less instructed people, have a feeling of satisfaction and intellectual rest when an adequate mechanical "explanation" is given of some natural phenomenon.

Newton, with the characteristic boldness of genius, extended the Galilean mechanics of earthly matter to the heavenly bodies, and (as often happens) found in the remoter phenomena better and more complete confirmation of his theory than in the nearer and more obvious manifestations. With the single additional assumption of the gravitational force, all the intricate wanderings of sun, moon and planets in the celestial sphere fell into a system —simple, orderly and in accord with our commonest experiences of every-day life. It is not surprising that to all minds capable of understanding it, Newton's theory carried instant conviction.

Nature and Nature's Laws were hid in night,
God said, "Let Newton be," and all was light.

But the law of gravitation did not enjoy the same independent status in the minds of natural philosophers; from that day to this they have been under temptation to find what we all call an "explanation" of it, while few if any have ever felt the necessity for an explanation of the laws of motion. Newton himself, in the "Opticks," speculates as to a possible ethereal explanation of gravitation; and even in the celebrated passage at the end of the "Principia," in which he renounces hypotheses, the context shows, I think, that he felt strongly the desire for an explanation, but was compelled to forego it because "hitherto I have not been able to discover the causes of those properties of gravity from phenomena."

The century following Newton was devoted to the development of mechanics and of gravitational astronomy and culminated in the great achievements of Lagrange and Laplace. There was some discussion as to the relative merits of action at a distance and *vis a tergo*, and some direct attempts to account for gravitation on the latter basis—notably that of LeSage early in the nineteenth century. But, on the whole, the opinion gained strength that Newton had been right in his view that there was little hope of being able to test such theories by comparison with "phenomena."

The discovery by Coulomb that magnetic and electric forces conformed to the Newtonian law gave strength to the prevalent opinion that this law was fundamental in the constitution of the physical universe. The mathematical technique of the subject was highly developed and there was a growing tendency to explain observed phenomena by distance-forces between particles, rather than to seek a more strictly dynamical theory to account for such forces. This procedure was certainly defensible upon philosophical grounds, and proved its utility in many problems of mathematical physics. It was the prevailing fashion in the early part of the nineteenth century.

Thus it was entirely natural that Ampère, when he heard in 1820 of Oersted's discovery, should have based his investigation of electrodynamics upon the Newtonian model, by using current-elements acting upon each other by forces in the line joining them. Again the law proved to be that of the inverse square; but the fact that the attracting elements were directed quantities added many difficulties which, in the state of mathematical science at that time, gave ample scope to the "Newton of electricity" for the display of his genius. These vector relations involve an indeterminateness which later gave rise to many rivals to Ampère's theory; other expres-

sions for the forces between elements gave the same results when integrated around closed circuits, and no one succeeded in devising experiments which would discriminate between them. Even Ampère, however (like the great predecessor whose name Maxwell connected with his), was not immune from the inherent desire of the physicist for "explanations" of distance-forces, though he was compelled to forego them because no way appeared for putting them to an experimental test. At the beginning of the memoir,[2] in which he sums up his electrodynamic researches, after declaring his adherence to the Newtonian procedure and renouncing anything in the nature of Cartesian vortices which Oersted's discovery had in a measure revived, he says:

> I have made no attempt to find the cause of these forces, well persuaded that any attempt of this kind ought to be preceded by the purely experimental knowledge of the laws and by the determination from these laws alone of the value of the elementary forces, whose direction is necessarily that of the straight line drawn through the material points between which the forces act.

Later in the same memoir[3] he disclaims any intention to assert that his forces are to be regarded as "truly elementary" and calls attention to previous attempts of his own[4] to "assign a cause for these forces in the reactions of the fluid filling all space whose vibrations produce the phenomena of light."

Simultaneously with these developments and partly in consequence of some of them, the employment of imponderable fluids became very general in theoretical physics. In electrostatics and magnetism, the gravitational analogy required some sort of attracting or repelling substance; in the theory of heat, the calorimetrical experiments of Black and his clear discrimination between temperature and quantity of heat, led directly to a substantial theory of heat. There was no great encouragement for the attempt to apply the principles of mechanics to these imponderables; so far as experiment showed they lacked not only the conspicuous property of weight, but also the most essential dynamical characteristic of ordinary matter, viz., inertia. The natural and fertile method of dealing with them was to take some empirical relations, as simple and fundamental as possible, as postulates for the mathematical development of the subject. Some of the most epoch-making advances in theoretical physics are instances of this method; as examples one needs only to recall Fourier's theory of heat conduction (afterwards applied by Ohm to the conduction of electricity), and Carnot's deduction of the theory of heat engines from the empirical principle which we now call the second law of thermodynamics. In fact, the great physicists who flourished during the first three or four decades of the nineteenth century seem to have felt that there was little hope of giving dynamical explanations of all physical phenomena. Thus Fourier, in the introduction of his great work, recounting the glorious achievements of Newton and his successors, says:

> It is recognized that the same principles regulate all the movements of the stars, their form, the inequalities of their courses, the equilibrium and oscillations of the seas, the harmonic vibrations of air and sonorous bodies, the transmission of light, capillary action, the undulations of fluids, in fine the most complex effects of all the natural forces; and thus has the thought of Newton been confirmed; *quod tam paucis tam multa praestet geometria gloriatur.*

"But," continues Fourier, "whatever may be the range of mechanical theories, they do not apply to the effects of heat.

[2] *Mem. de l'Acad.*, VI., p. 177 (1825).

[3] P. 294.

[4] "Recueil d'observations électro-dynamiques," p. 215.

These make up a special order of phenomena which can not be explained by the principles of motion and equilibrium." His attitude may fairly be taken as, in general, characteristic of his time; there were sharp lines of demarkation between the different departments of natural philosophy which would doubtless cause feelings of surprise and discomfort to a modern physicist if he could suddenly find himself at a meeting of the Royal Society or of the Paris Academy in the year 1822. These barriers were to a considerable extent broken down in the forties by the discovery and development of the principle of the conservation of energy. It was not simply the quantitative relation which excited the enthusiasm of the men of that time, but the knowledge that there was a "correlation of Physical Forces"; their reception of the discovery shows how much such a relation had been wanted.

The psychology of physicists made it inevitable that energy should be regarded as something more real than a mathematical expression which remains constant during various processes. It was given a quasi-substantial interpretation and localized in space; and it was most natural that its newly recognized forms should be identified as nearly as possible with the familiar energy of ordinary mechanics. Thus we had at once a *mechanical* theory of heat which led to a great extension of molecular hypotheses; and the desire to deduce the empirical second law from dynamical principles was the motive for the development of statistical mechanics through the successive stages shown in the work of Maxwell, Boltzmann and Gibbs.

This tendency toward dynamical explanations was strengthened by the progress of the wave-theory of light. After the brilliant experiments and interpretations of Young and Fresnel it was impossible to doubt the kinematical similarity of light to a transverse wave motion. This made it necessary to postulate an ether and to give it suitable properties; the theory of waves in an ordinary material elastic solid was developed by Green, Cauchy, Thomson and others and compared with the phenomena of light. The lack of complete agreement was a stimulus to the investigation of other possible types of elastic substances conforming to the general laws of mechanics. In the hands of MacCullagh, Stokes, and especially of Kelvin, these investigations led to great advances in our knowledge of the properties of continuous media, and showed the dynamical possibility of the existence of media which were quite different in their elastic properties from ordinary matter.

Another current of thought which influenced profoundly the complex development of theoretical physics in the nineteenth century was the strong prejudice of Faraday against action at a distance and his instinctive preference for a mode of representation which involved the transfer of forces from point to point by the interaction of contiguous parts of a continuous medium. The fertility and usefulness of this method in electromagnetism is attested not only by Faraday's unparalleled success as a discoverer (for genius choses the method best suited to itself), but also by the fact that it has held the field in elementary instruction as well as in the most complicated applications of electrical engineering. We all know how Maxwell deliberately submitted himself to the influence of this prejudice, and the epoch-making result which followed from its union with his mathematical skill. The inclusion in a single theory of two great bodies of phenomena, those of light and those of electricity, was an achievement of

the first magnitude and an immense stride in the direction of the unification of natural causes. But it did not satisfy the thoroughgoing dynamical prejudices of Lord Kelvin, who insisted to the end of his life that he did not "understand" the electromagnetic theory and that it "has not helped us hitherto." Maxwell himself was scarcely less desirous of finding a dynamical foundation for his theory. In fact, its first form was a detailed mechanical model of vortices and idle wheels; in the final form details were avoided by the use of the generalized dynamics of Lagrange and Hamilton, and Maxwell succeeded in showing that certain parts at least of his theory could be based upon dynamical principles.

This use of Lagrangian and Hamiltonian methods in the investigation of physical phenomena was a new weapon in the hands of those who sought to reduce them all to a dynamical basis. It has been used with effect by J. J. Thomson, Larmor, and (in application to statistical mechanics) by Gibbs. It makes feasible the ultimate refinement and completeness of dynamical explanation; in place of the potential energy in the Lagrangian function we may substitute the kinetic energy of concealed motions and thus the last vestige of unexplained distance-forces may be swept away.

The most thoroughgoing and successful example of this method is the very comprehensive theory of the physical universe contained in Larmor's "Æther and Matter" published in the last year of the nineteenth century. His ether is identical with MacCullagh's rotationally elastic medium; it has imbedded in it centers of rotational strain (the electrons), out of which the atoms of matter may be built up. The only assumptions are that the positive and negative electrons are somehow prevented from destroying each other and that they, with their fields of strain, are capable of motion through the fixed medium. From Hamilton's principle, the Maxwellian equations for the free ether are deduced and, in the presence of matter (electrons), whether at rest or in motion, the same relations hold as those found experimentally. The rotational elasticity of the medium may be produced gyrostatically, so that the potential energy may, if one chooses, be replaced by kinetic. It is interesting to observe that the position, velocity and momentum of a material particle, in this theory, are really Lagrangian, generalized values. The motion of the centers of strain (*e. g.* in a straight line) cause a slight twisting and untwisting motion of the ether where the true mass and momentum reside. Thus the apparent mass of Larmor's electron varies with its speed as that of cathode rays was afterward found to do; but its dynamical orthodoxy is as sound as that of a steam-engine governor, whose moment of inertia varies with its angular velocity.

Notwithstanding the triumphs of the dynamical school of thought, its assumptions and methods were subjected to searching criticism on philosophical grounds particularly by Kirchhoff and Mach. In Kirchhoff's "Lectures on Mechanics," published in 1876, he explicitly renounces the attempt to find the causes of natural phenomena or to "explain" them in the traditional sense; the purpose of mechanics itself (to say nothing of the parts of physics more remote from common observation) is simply the description of phenomena. Forces as *causes* of motion are rejected; they are merely convenient abbreviations for certain functions of observed motions. In the first lecture he points out that Newton by no means discovered that the force of gravitation was the cause of the motion of the planets which Kepler had described; he only

showed that the description was simpler and briefer if expressed in terms of the second differential coefficients instead of the first. Similar ideas have been developed with greater generality by Mach, who finds the final purpose of scientific theories to be economy of thought, and classes the search for causes, explanations and dynamical theories, among the metaphysical prejudices which hinder the progress of science.

The criticism of Kirchhoff and Mach is logical and convincing. No unprejudiced person can doubt that, after a discovery is made, it may be interpreted in their way and that, on the whole, this interpretation is the cleanest, most rational and most free from human weakness. But from the pragmatic point of view, and in the light of experience of the course of science in the past, it may well be doubted if their attitude of mind is a useful one in the work of investigation and discovery as distinguished from subsequent criticism and clarification. A somewhat extreme example of militant advocacy of the descriptive method was furnished about twenty years ago by the school of energetics under the leadership of Ostwald. Any use of atomic hypotheses was by them regarded as evidence of feebleness of intellect and slavery to metaphysical prejudices. Their opinions were based upon an incomplete acquaintance with the state of physical knowledge even at that time; they were vigorously opposed in numerous papers by Boltzmann who demonstrated "the indispensability of atomistics in natural philosophy" in a most convincing manner. As we all know, the progress of experimental discovery has long since convinced the energeticians that no adequate description of material phenomena can be given without the use of atomic theories.

Boltzmann has also pointed out[5] that even the most elaborate and detailed mechanical theories of Kelvin or Maxwell, for example, are regarded by their authors themselves merely as models; that description by means of models, if accurate and convenient, is quite as legitimate as description by means of differential equations; and that the method could be thus amply justified even on the most sophisticated philosophical principles.

It may, I think, safely be said that the most remarkable example in physical science of the purely descriptive theory—the one with the least taint of the fallacy of cause and effect—is Einstein's theory of relativity. All of us who studied our Maxwell in the early nineties or previous to that time, and who have kept an interested eye upon the progress of electrodynamics in the intervening years, are aware of the great difficulties which were encountered in the attempt to extend the Maxwellian electrodynamics to moving bodies. Maxwell and Hertz both went astray in that portion of the subject. We all remember how these difficulties were slowly cleared up, step by step, especially by the masterly work of Lorentz, but with important contributions by J. J. Thomson, Heaviside, Larmor, FitzGerald, Max Abraham and others. What we now call the electron theory had its origin in this attack upon the electrodynamics of moving matter, and was not the result of any prevision that within a few years we should be able to handle, and experiment with, the disembodied electrons themselves. The final puzzle was the reconciliation of the result of the Michelson-Morley experiment with the facts of aberration, the Fresnel "coefficient of entrainment" and other optical knowledge. Most of us can remember the great perplexity which this caused; and it

[5] "Populäre Schriften," p. 1.

did not at first sight appear to be helped very much by FitzGerald's suggestion, contained in a memoir by Lodge[6] "that the cohesive force between molecules, and, therefore, the size of bodies, may be a function of their direction of motion through the ether; and accordingly that the length and breadth of Michelson's stone-supporting block were differently affected, in what happened to be, either accidentally or for some unknown reason, a compensatory manner. This seemed a rather desperate dodge; and the impression was not removed until Lorentz (who had independently made the same suggestion) showed[7] that just the right alteration of dimensions would take place if the intermolecular forces were of electrical origin. Later the experimental results of Rayleigh and of Brace forced him to the conclusion that the electron itself must be similarly contracted. and one of the consequences of his hypothesis was brilliantly verified by Bucherer.

Upon one who had followed step by step this slow and laborious, but highly interesting, course of development, with its constant action and reaction of theory and experiment upon each other, the impression of directness and simplicity made by Einstein's papers of 1905 can scarcely be exaggerated. The difficult and (at first sight) irreconcilable results of experiment, which the older theory had conscientiously "explained," were taken by Einstein as his postulates. There remained only to describe the world as it appears to an observer limited by these restrictive postulates; this proved to be (for Einstein) an apparently easy task and resulted in the Lorentz equations for bodies in motion, slightly improved, in that some relations which Lorentz had obtained only approximately were now exact. Since description and not mechanism is the essence of the method, it is unnecessary to postulate an ether; and since an observer at rest with reference to the ether would have no detectable advantage over one who was in motion, the assumption of an ether was not only useless, but actually in the way of clear description. This rejection of the ether has made Einstein's theory unpalatable to many physicists, while others (as well as many mathematicians) have been so carried away with its beauty and elegance that the use of the word ether is to them *distinctly offensive*. A simple rule, however, enables one to converse peaceably with either group separately; the same statements and arguments may be addressed to both, provided the word "observer" is substituted for "ether," or *vice versa*.

If we consider Einstein's theory from the pragmatic point of view we cannot fail to recognize that no new discoveries in electrodynamics have resulted from its suggestions. In this fact there appears to be support for the opinion that a theory of this type is not valuable as an instrument of research, but finds its proper place as a succinct summary of a body of knowledge after that knowledge has been acquired by other means. There are a number of considerations, however, which serve as a warning against this generalization, of which I will mention but two.

I would first call your attention to the fact that the development of thermodynamics, as based upon the two empirical laws, exemplifies a method which is very similar to that of Einstein; and we must all recognize its enormous services in the advancement of science. It has constantly served as the guide in important experimental investigations, and has predicted results which could scarcely have been foreseen on the basis of the more detailed

[6] *Phil. Trans. R. S.*, 184, p. 749 (1893).

[7] "Versuch einer Theorie," etc., § 92.

molecular and statistical theories. The converse is also true, as Boltzmann so stoutly maintained; and I think we must recognize that the progress of thermodynamics has been greatly facilitated by the interplay and mutual reaction of both types of theory.

The second example is a more direct one; it is the remarkable theory of gravitation in which the highly individual genius of Einstein has again manifested itself. It is too early to come to a definite conclusion as to its validity. It has had one striking verification in the deduction of the correct value for the unexplained motion of Mercury's perihelion; but this agreement may conceivably be due to accident and, in any case, its evidence is too slender to be regarded as establishing the theory. But we must face the distinct possibility of its ultimate success; and, in that case, we can not fail to recognize it as a brilliant triumph of the descriptive method. It is difficult to believe that any living physicist except Einstein could have constructed this theory even with the help of Minkowski's highly simplified method of description by means of four-dimensional geometry; but it is quite beyond belief that such a theory could have arisen at the present time by the use of any of the more usual methods of theoretical physics.

There is one further matter in this connection to which I should like to invite your attention. It is the question of the complete validity of Einstein's original postulate of relativity. There can be little doubt of its correctness when applied to motions of translation; speaking in terms of the ether, we may be reasonably confident that it is impossible to detect the effects of uniform translation relative to the ether. But little has been accomplished in extending the theory to motions of rotation; indeed, rotation has always been a stumbling-block to a purely relative theory of motion, as soon as dynamical considerations are introduced. As Maxwell says:[8]

> So far as regards the geometrical configuration of the earth and the heavenly bodies, it is evidently all the same
>
> "Whether the sun predominant in heaven
> Rise on the earth, or earth rise on the sun;
> He from the east his flaming road begin,
> Or she from west her silent course advance
> With inoffensive pace that spinning sleeps
> On her soft axle, while she paces even,
> And bears thee soft with the smooth air along.'"[9]

But, as we all know, the plane of Foucault's pendulum remains fixed with reference to the stars, and this has usually been interpreted as proving by dynamical means the absolute rotation of the earth. The thoroughgoing relativist replies, however, that the contrary supposition is equally possible; it would merely require a restatement of the principles of mechanics which happen (for some unknown reason) to take on their simplest form when referred to axes fixed with respect to the stars. The new statement of the laws of motion would seem to us very unnatural, but the essential point is not their strangeness, but that they would be *different*. To cause them to transform into themselves, as Maxwell's equations do when subjected to the Lorentz-Einstein transformation, would apparently require curious assumptions of curved space, and of time recurrent after twenty-four-hour periods, which would certainly be very foreign to the ordinary habits and preferences of the human mind, whether we assume that these habits are inherent or acquired. Even from the point of view of convenient description it seems likely that we shall do better by adhering to the belief that the stars are fixed and that the earth rotates. We must, however,

[8] "Matter and Motion," p. 154 (Van Nostrand, 1878).

[9] "Paradise Lost," Book 8, ll. 160 et seq.

admit that relativists are quite within their rights when they demand an answer to the question, "Fixed with reference to what; rotates relative to what?" Here, it seems to me, is a possible field of usefulness for the ether in addition to its original function of serving as nominative case to the verb "to undulate." This appears the more likely when we consider that the earth's magnetism has never received an explanation—or, if one chooses, a description which connects it with other physical phenomena.

I have left to the end the consideration of the most revolutionary change which the twentieth century has brought about in the outlook and methods of theoretical physics—the rapid development and great successes of the quantum hypothesis of Planck. As we have seen, the fifty years following the discovery of the conservation of energy were marked by the steady progress of dynamical theories and the conquest by them of one disputed position after another. It is true that the victory was never quite complete, that the models were always in some degree imperfect and approximate; but the success was, on the whole so great that it seemed to justify the hope that only time and labor were necessary to clear away present difficulties as so many had been overcome in the past. It had not been easy to bring thermodynamics and irreversible processes into the dynamical system, but so far as material systems were concerned, most physicists were in agreement that it had been successfully done. It is true that a violation of the second law of thermodynamics could not be shown to be impossible; but its improbability was so great that there was no reasonable expectation of its ever being observed by finite human beings. The most complete and general exposition of this great triumph of the dynamical hypothesis is contained in the "Statistical Mechanics" of Willard Gibbs, which was published in 1902, but which had been completed and given in the form of academic lectures by the author for some years previous to that date. As in all of Gibbs's work the assumptions and the results were of a very general character; but he was quite aware that at one point they were too restricted. He says:[10]

> Although our only assumption is that we are considering conservative systems of a finite number of degrees of freedom, it would seem that this is assuming far too much, so far as the bodies of nature are concerned. The phenomena of radiant heat, which certainly should not be neglected in any complete system of thermodynamics, and the electrical phenomena associated with the combination of atoms, seem to show that the hypothesis of systems of a finite number of degrees of freedom is inadequate for the explanation of the properties of bodies.

The difficulties involved in the possession by the continuous ether of an infinite number of degrees of freedom were brought more clearly to light in 1900 by Lord Rayleigh's formula for black body radiation. It was quite irreconcilable with the measurements of Paschen and, moreover, it led to a kind of superdissipation of energy into high frequency vibrations of the ether which appeared entirely out of accord with the facts of empirical thermodynamics. Paschen's observations were well represented by the formula which had been obtained by Wien, who assumed the Maxwellian distribution of velocities among the molecules of the black radiator, and also that the wave-length radiated by any molecule was a function of its velocity. Later experiments by Lummer and Pringsheim and by Rubens and Kurlbaum, with longer wave-lengths and higher temperatures, approximated to the Rayleigh formula.

[10] "Statistical Mechanics," p. 167.

Planck endeavored to find a mathematical compromise which should reduce to Wien's formula when λT was small and to that of Rayleigh when λT was great. In this way[11] he was led to the celebrated formula which has proved to be of such unexpected importance in the development of theoretical physics. In its original publication, however, the formula was otherwise deduced.[12] Planck had previously calculated the entropy of a system of linear resonators and believed that he had proved Wien's formula to be a necessary consequence of the second law.[13] To obtain the new formula (by a process similar to that of Boltzmann in the kinetic theory of gases), he found it necessary to assume that energy was absorbed and radiated discontinuously. To satisfy Wien's displacement law these discrete energy quanta must be proportional to the frequency of the radiation, and thus the constant, h, came into existence.

The process was not very convincing and I suppose that, if nothing else had come of it, Planck's result would have been regarded as an empirical formula for which a satisfactory theoretical basis was lacking. But there were other puzzles which were, at nearly the same time, troubling the minds of physicists. One was the curious relation between X-rays of a certain hardness and the speed of the secondary electrons which they caused to be emitted from a metal. We all remember how Bragg was led by these difficulties to support a corpuscular theory of X-rays. The same difficulties existed in the case of photo-electrons and the ultra-violet light which liberated them. Einstein also proposed a quasi-corpuscular theory in which, however, instead of actual corpuscles, he substituted light-quanta whose energy was equal to Planck's $h\nu$. It was not difficult to show, as Lorentz did, that Einstein's quanta were quite irreconcilable with the phenomena of diffraction; but the fact remains that the quantitative predictions of his theory have been verified in the case of both X-rays and light, in the latter instance with great accuracy by Professor Millikan and his pupils.

Time permits only the barest mention of Debye's daring application of Planck's formula to the elastic vibrations of solid bodies, his calculations of their specific heats upon this basis, and the remarkable agreement of the calculated values with the experimental results of Nernst and his collaborators. I must be equally brief in referring to Bohr's theory of line spectra in which the *form* of the Balmer progression is undoubtedly introduced in the assumptions; but the numerical value of Rydberg's constant is accurately calculated from the mass and charge of the electron and the inevitable h. In all these applications the same characteristics are observable: the fundamental ideas are not clear and precise, except arithmetically; if we try to make them so, we encounter apparently insuperable contradictions with some of the most firmly established experimental facts; the deductions from the premises do not follow inevitably, but must be helped out by special hypotheses in each different application; but numerical relations of surprising exactness are obtained, and an account is given of whole classes of phenomena which seem to be quite beyond the scope of the "classical" methods of twenty years ago. We do not know whether Planck's constant is an atom of Hamiltonian action, or of angular momentum, or of something quite different from either; but we can not doubt that it is a physical constant comparable in importance with the

11 Planck, "Wärmestrahlung," 1te Aufl., p. 219.

12 Planck, *Ann. d. Phys.*, 4, p. 553 (1901).

13 *Ann. d. Phys.*, 1, p. 118 (1900).

velocity of light and the electronic charge.

Poincaré's demonstration of the necessity for discontinuities in atomic processes if the total black radiation is to remain finite has not yet been successfully questioned. If it stands, we must not only give up the hope of bringing the phenomena of physics under the sway of generalized dynamics—we must renounce even the humbler ambition of describing them, in all their details, by means of differential equations. It will certainly be a triumph of the atomistic method—though unexpected and somewhat embarrassing to its most ardent supporters—if our very mathematics must become atomic.

The present state of theoretical physics is obviously one of transition, with all the discomfort that such a state involves. We are waiting for a synthesis of elements which are apparently discordant and mutually contradictory. The experience of the past forbids us to doubt that the necessary reconciliation will come in time; and we can foresee that it will be comparable with the greatest generalizations in the history of science. It may be that we must await the appearance of another Newton; or it may be that the result will be achieved in a more democratic manner by the cooperation of many lesser men.

H. A. Bumstead

Yale University

CYRILLE GRAND'EURY

The writer has waited some months in the hope that some one whose acquaintance was not limited to an occasional interchange of letters might publish a note of appreciation of the life and work of this savant—the last of the illustrious trio of paleobotanist, Renault, Zeiller, Grand'Eury—who made the French Carboniferous and Permian floras classic and a standard for the whole world.

François Cyrille Grand'Eury was born at Houdreville (Meurthe) on March 9, 1839. He was a mining engineer by profession and early in his career he became interested in the fossil plants of the Carboniferous, publishing a paper on the St. Étienne flora as early as 1869. His large work on the Loire flora, a folio monograph of 624 pages and 27 plates, was published as a memoir of the French Academy in 1877 and is one of the most comprehensive works of its kind ever printed. The only other large systematic work from his pen was that on the geology and paleontology of the coalfield of the Gard published in 1890.

Grand'Eury was always much interested in the stratigraphic applications of his subject, in the conditions of growth of the coal plants, and the origin of coal—subjects upon which he repeatedly published. He may be said to have established the chronologic succession of floras for the coal seams of the Stephanian, named from the typical development of this stage at St. Étienne. Probably no other student of Carboniferous floras had so thorough a field experience or saw one tenth the amount of material in place in the rocks as did Grand'Eury. Consequently his observations on the habit, sizes and positions of growth of the various Cordaites, Lepidophytes and Calamites are especially trustworthy. His name is inseparably associated with the elucidation of the habit and morphology of Cordaites and his restorations of these and other coal plants are to be found in every text-book.

He published a memoir upon the formation of coal in the *Annales des Mines* in 1882, a subject to which he returned in his paper before the International Geological Congress in 1901, and in his last large work commenced in 1912. He was not a voluminous writer and with the exception of his work on the Carboniferous plants of the Spanish peninsula, embodied in lists of species, all of his work was centered on the French floras. Nor did he, so far as I know, publish anything in the fields of Mesozoic and Cenozoic paleobotany, unless his paper of 1902 on the formation of stipite, brown coal and lignite can be so considered.

He did, however, contribute a very large

number of short papers to the *Comptes rendus* of the French Academy, among which those later ones relating to the habits and seed-like fructifications in *Callipteris, Neuropteris, Pecopteris* and *Sphenopteris* are especially noteworthy. His last great work, commenced in 1912 with the collaboration of his son, one showing where his chief interest centered, was entitled "Recherches géobotaniques sur les Forêts et Sols fossiles et sur la végétation et la Flore Houillères." Influenced by his experience in the fresh-water basins of central France, he was an advocate, albeit an impartial one, of the allochthonous origin of coal beds.

He was elected to the Société Géologique in 1877 and hence was one of the oldest surviving members at the time of his death. He was elected a correspondent of the Institute in botany in the spring of 1885. Throughout a reasonably long life he was actively engaged in mining work and was long a resident of St. Étienne, where he was an honorary professor in the School of Mines. A few years ago he removed to Malzéville, a suburb of Nancy, where he died on July 22, his death undoubtedly hastened by the untimely fate of his son on the field of battle.

In Grand'Eury science has lost another admirable representative of the French school. Of a kindly disposition, generous and courteous in all his intercourse, well informed in all he wrote, he will be sadly missed among the depleted ranks of paleobotanists among whom he labored for over half a century. With the sorrow of Zeiller's death still heavy, we have now to lay wreaths on the tombs of memory for Grand'Eury, and for his recently departed colleagues—Lignier, of Caen, and Bertrand, of Lille—would that Cuvier were still alive to fittingly pronounce their éloges.

E. W. B.

SCIENTIFIC EVENTS

ORNITHOLOGICAL FIELD WORK IN 1917

IT is stated in the *Auk* that, while war conditions have necessarily curtailed activity in various directions and especially in field work, the museums have sent out expeditions and special collectors.

The Museum of Vertebrate Zoology of Berkeley devoted its attention chiefly to the southwest. H. S. Swarth visited southern Arizona and obtained material for a report on the birds found on the Apache Trail, while Grinnell and Dixon spent some time in the Death Valley region in California. In the north W. E. C. Todd was in the field five months in charge of the Carnegie Museum Expedition to northern Quebec. In tropical America the activity of previous years has decreased with the return of the American Museum Expeditions from South America but one party, comprising Messrs. Miller, Griscom and Richardson, spent four months collecting for the Museum in Nicarauga. In the West Indies, Haiti and San Domingo have been the center of attraction. W. L. Abbott, Rollo H. Beck, and Paul Bartsch visited the islands at different times and each secured some remarkable birds or made substantial additions to our knowledge of the local avifauna. In South America Beebe spent some time at the tropical laboratory near Georgetown, British Guiana, and Beck returned from southern Patagonia with rich collections of sea birds. From the Orient the American Museum Expedition to China, Yunnan, and northern India in charge of Roy C. Andrews returned after successfully completing its field work, and from Celebes, H. C. Raven sent some valuable collections of birds to the U. S. National Museum.

In the United States the work of the Biological Survey has been carried on with the usual activity in a number of states. In the south A. H. Howell continued his field studies of the birds of Alabama and Francis Harper visited the Okefinokee Swamp in Georgia and the everglade region in Florida. In the west H. H. T. Jackson began work on a biological survey of Wisconsin and H. C. Oberholser investigated the breeding ground of waterfowl in North Dakota. In Montana E. A. Preble collected in the southeastern part of the state south of the Northern Pacific Railroad, and Mr. and Mrs. Vernon Bailey spent some weeks studying the birds of the Glacier National

Park and collected material for a report to be issued in cooperation with the National Park Service. In the Northwest preliminary work on a biological survey of Washington was begun by W. P. Taylor and in the southwest E. A. Goldman collected in northern Arizona south of the Grand Canyon.

THE ANNUAL MEETING OF THE NEW YORK ZOOLOGICAL SOCIETY

The New York Zoological Society held its annual meeting on the evening of January 8 at the Waldorf-Astoria Hotel. When Professor Henry Fairfield Osborn, president of the society, called the meeting to order, there were more than a thousand members and their friends present.

In his annual report Madison Grant, chairman of the executive committee, said that the attendance at the New York Zoological Park and at the aquarium showed a substantial increase over 1916. The attendance at the park during 1917 was 1,898,414, and that of the aquarium 1,595,118, making a total attendance of 3,493,532. The cost per visit was about 7 cents for these two institutions during the past year. The number of exhibits at the park is about the same as last year, although there has been a slight increase in the number of species. There are over 4,000 animals at the park at the present time. The collection at the aquarium shows a slight increase over last year, and there are now more than 6,000 living specimens on exhibitions.

In his report, Dr. Charles H. Townsend, director of the aquarium, said that present conditions were almost intolerable because sea water invaded the engine-room and passed throughout the basement of the entire building through the pipe galleries. The result was that the building was unsanitary. Application would be made to the city, Dr. Townsend said, for an appropriation of $100,000 to remove the boilers and engines to the front of the building beyond the reach of sea water. One of the advantages of this alteration, he pointed out, would be increased exhibition space and more room for office work.

Dr. William T. Hornaday, director of the Zoological Park, after making his report, called attention to the need of Congress ratifying the arrangement between the United States and Canada for the protection of migratory birds. Dr. Hornaday said that Canada had already accepted the proposal and diligently and forcefully carried it into effect, despite the distraction of her participation in a great war. The arrangement, he said, had been held up in the Foreign Relations Committee of the House of Representatives, and he urged that action be taken at once. He declared that our food supply depended to a large extent on the enactment of this bill, as the migratory birds feed on crop-destroying insects. A resolution which he offered urging the President and Congress to take immediate action was unanimously adopted by the meeting. Two series of pictures, one a motion picture taken in the Marine Biological Laboratory at Naples, Italy, by Dr. Edward Bosio, and the other a series of natural-color pictures taken by Mrs. Roy C. Andrews in the Chinese province of Yunnan, were shown for the first time. Pictures taken by Donald B. MacMillan on the recent Crocker Land Expedition sent out by the American Museum of Natural History and the American Geographical Society were also shown, as well as motion pictures taken in the New York Zoological Park by Raymond L. Ditmars.

WARTIME SERVICE OF THE UNIVERSITY OF CALIFORNIA

According to the report presented by President Benjamin Ide Wheeler to the regents of the University of California at their December meeting, nearly three thousand students, alumni, former students and members of the faculty of the University of California are now in military or naval service. The University of California has organized and has been conducting since May 21 a school of military aeronautics, in which some five hundred flying cadets are now being trained in an eight-weeks course. A new contingent is admitted each week. The university is now teaching forty-five men in a school of navigation, conducted in conjunction with the U. S. Shipping Board, for the training of officers for the merchant marine. For the third time, a six-weeks' course is about to be begun for the

training of chief storekeepers for the Ordnance Department of the U. S. Army.

The undergraduate men remaining at Berkeley are organized as a unit of the Reserve Officers Training Corps. A course in naval engineering will be inaugurated in January, which by one year of special training will qualify men for examination as ensigns in the Navy. Courses in naval architecture and military engineering are also to be offered. An institute for home service has been conducted at the request of the Red Cross, for the training of home-service relief workers. A military information office maintained by the university in the office of the alumni secretary has advised thousands of men as to how to find opportunity to serve the nation in its war-time emergency where their special training will be of most service.

The department of agriculture has turned practically its whole activity toward speeding up the production of food in California, with notable results. Special researches are being carried on at the request of the National and the State Councils of Defense by experts in the fields of agriculture, astronomy, botany, chemistry, economics, engineering, geology, medicine, psychology, zoology, etc.

Between April 6 and October 31, 1917, the University of California expended or administered for specific war purposes a total of one hundred and sixty-one thousand dollars.

The University of California Medical School has sent into service Hospital Unit No. 30, under Major E. S. Kilgore, with twenty-three members of the faculty of the medical school among its officers. The medical school has conducted thousands of examinations for military or naval service, and many other examinations for the California State Board of Health, in connection with the selective draft.

Dr. T. Brailsford Robertson, professor of biochemistry, has isolated the new growth-controlling substance, "Tethelin," and has given his patents to the university for the endowment of medical research. This new substance promises to be of great value in causing the rapid healing of wounds or fractured bones which had previously refused to yield to treatment.

The staff of the Hooper Foundation for Medical Research are obtaining valuable results in investigations concerning anemia, shock, typhoid carriers, and other problems of war-time significance.

The University of California Dental School is giving free dental care to men who through defects of the teeth would otherwise be disqualified under the selective draft, and a large number of its faculty and alumni have become officers in the Dental Service of the Army.

The diversity of tasks which individual members of the faculty of the University of California are carrying on as war-time emergencies may be illustrated by brief mention of some of the activities in which some of the members of the faculty are engaged:

President Benjamin Ide Wheeler is chairman of the Committee on Resources and Food Supply of the California State Council of Defense, represented Governor Stephens at the conference of the states, and has been active in varied fields of war-time work. David P. Barrows, professor of political science, has been commissioned as a major and has gone to the Philippines, where his eight years of experience as director of education and as chief of the Bureau of Non-Christian Tribes will be of special value in military intelligence work. Dean Herbert C. Moffitt, of the medical school, is a major in the Army Medical Service and at the head of a hospital at a training camp, and so in charge of the health of some thirty thousand men. Comptroller Ralph P. Merritt is federal food commissioner for California. Gilbert N. Lewis, dean of the college of chemistry, has been commissioned as a major in the Ordnance Corps and has been sent to France for gas work. Dr. William Palmer Lucas, professor of pediatrics in the University of California Medical School, is in France, in charge of the Children's Bureau of the Red Cross for France and Serbia. Professor W. B. Herms, of the department of agriculture, has been making an entomological survey of sanitary conditions in the neighborhood of the cantonments of the western depart-

ment of the Army, to aid in preventing the spread of those diseases, such as malaria, which are carried by insects. Professors H. M. Hall and T. H. Goodspeed, of the department of botany, have been investigating certain native plants of California which can be used as a source of rubber in case of national necessity. Practically all of the members of the department of chemistry are engaged in confidential researches as to chemical problems the national authorities have asked them to take up. Professor Stuart Daggett, of the department of economics, has reported on the supply of iron and steel on the Pacific coast and Professor Henry R. Hatfield, of the department of economics, dean of the college of commerce, has reported on the relation of the state banks to the Federal Reserve System. Professor F. E. Pernot, of the department of electrical engineering, is in Washington aiding with various war-time electrical problems. Professor Charles Gilman Hyde, of the chair of sanitary engineering, designed fifteen miles of sewer system for Camp Fremont. Professor C. C. Wiskocil and his colleagues in the civil engineering department have made tests of airplane fastenings and woods to be used in the construction of airplanes. Professor C. L. Cory, dean of the college of mechanics, has investigated problems in the fixation of nitrogen from the air by direct electric arc furnace process. Professor B. M. Woods, of the deparment of mechanics, as president of the Academic Board of the School of Military Aeronautics, is directing the instruction given to the flying cadets. Professor George D. Louderback, of the department of geology, has reported on sources for a supply of manganese ores. Professor George M. Stratton, as a captain in the Signal Corps, is enlisting officer in San Francisco for the Aviation Service, and he and Professor Warner Brown, of the department of psychology, have developed tests to determine the fitness of young men to become military aviators. Professor William E. Ritter, director of the Scripps Institution for Biological Research, has investigated the supply of food fishes in the Pacific Ocean not as yet used by the fishermen and the canneries. Professor C. A. Kofoid and Professor W. W. Cort, of the department of zoology, have investigated the hookworm, and organisms responsible for trench dysentery. Professor Lincoln Hutchinson, of the department of commerce, is in Washington as tin expert of the War Trade Board. Professor Joel H. Hildebrand has gone to Washington to become a captain in the Ordnance Department and to aid in coordinating the war-time researches of chemists throughout the country. George E. Dickie, of the department of military science and tactics, is the Pacific coast representative of the War Department and Navy Department Commissions on Training Camp activities. Professor H. B. Langille, of the department of mechanics, is an inspector of naval construction for the government, at the Union Iron Works.

SCIENTIFIC NOTES AND NEWS

M. Painlevé has been elected president of the Paris Academy of Sciences, succeeding M. d'Arsonval. M. Léon Guignard, professor of botany at the School of Pharmacy of Paris, has been elected vice-president.

The Nichols Medal for meritorious research in organic chemistry has been conferred on Professor Treat B. Johnson, of the Sheffield Scientific School of Yale University. The medal is awarded annually by the New York Section of the American Chemical Society on the merit of the original communications published in the journal of the society.

At the last meeting of the New York Section of the Society of Chemical Industry, the Perkin Medal was presented to Auguste J. Rossi, by Dr. William H. Nichols, past-president of the society, and Dr. F. A. J. Fitzgerald gave an account of Dr. Rossi and his work.

Dr. C. Gordon Hewitt, F.R.S.C., dominion entomologist and consulting zoologist, of the Department of Agriculture, Ottawa, has been awarded the gold medal of the Royal Society of Canada for the Protection of Birds, and has been elected an honorary fellow of the society, in recognition of his services to the cause of bird protection in England and in Canada,

and particularly in connection with the treaty between Canada and the United States for the protection of migratory birds.

PROFESSOR GEORGE GRANT MACCURDY, of Yale University, has been made a member of the Committee on Anthropology of the National Research Council.

PROFESSOR ROSWELL H. JOHNSON, of the University of Pittsburgh, and Professor Frederick Ehrenfeld, of the University of Pennsylvania, have been appointed by Governor Brumbaugh as commissioners of the Topographic and Geologic Survey Commission of Pennsylvania. Senator G. W. McNees holds over as the third member.

MR. PAUL M. REA has resigned the secretaryship of the American Association of Museums after eleven and a half years of service. Mr. Rea has been appointed vice-director of War Savings for South Carolina. The council has filled the vacancy for the remainder of the year by the appointment of Harold L. Madison, curator of the Park Museum, Providence, R. I.

MR. SCHACHNE ISAACS, instructor in psychology, University of Cincinnati, has been commissioned first lieutenant, Sanitary Corps, National Army. Lieutenant Isaacs is associated with Captain Knight Dunlap on the psychological research in high altitude aviation. He has been assigned to the Mineola, L. I., aviation camp where a laboratory is in process of construction.

GEORGE K. K. LINK, professor of plant physiology in the University of Nebraska, has been granted a leave of absence to undertake war emergency work in the Bureau of Plant Industry. He is engaged as pathologist in the market distribution and food survey work of the Department of Agriculture and is instructing the inspectors of the newly created inspection service in the detection of diseases of vegetable crops. This inspection service has been opened by the Bureau of Markets and covers the principal markets of the country. The Navy and Army, in purchasing vegetables for the fleet, for overseas supply ships and transports and the Quartermaster's depots, are making use of this service. Dr. Link is also investigating the occurrence of diseases of perishable vegetables in the terminal markets of the United States.

DR. HERBERT E. IVES, physicist of the United Gas Improvement Company, Philadelphia, Pa., lectured before the Franklin Institute of Philadelphia on January 10 on "The physics of the Welsbach mantle," and Professor W. P. Mason, of the Rensselaer Polytechnic Institute, lectured on January 16 on "Camp sanitation."

PROFESSOR CHARLES E. PELLEW is giving a course of four lectures, on Saturday evenings at 8 P.M., at the Metropolitan Museum of Art, upon "The dyestuffs of the ancients."

DR. LAWRENCE J. HENDERSON, professor of biological chemistry in Harvard University, will give a series of lectures on food conservation at Smith College. The lectures will be open to the public.

A SERIES of five lectures in the Herter Foundation were delivered from January 7 to 11, at the Carnegie Laboratory of the University and Bellevue Hospital Medical College, by Major Edward K. Dunham, M. R. C., U. S. Army, emeritus professor of pathology, on "Principles underlying the treatment of infected wounds."

A MEETING of the Faraday Society was held on January 14 in the rooms of the Royal Society of Arts, when a general discussion on the setting of cements and plasters was opened by Dr. C. H. Desch.

THE Ramsay Memorial Fund, which was instituted a year ago with the object of raising a sum of £100,000 as a suitable memorial to the late Professor Sir William Ramsay, has now reached a sum of just above £30,000. The latest and most important donation to the fund has been been a sum of £5,000, contributed by Mrs. Wharrie.

DR. A. H. PURDUE, state geologist of Tennessee, died as a result of an operation, on December 12, aged fifty-six years.

JOSEPH PRICE REMINGTON, since 1893 dean of the Philadelphia College of Pharmacy and a member of the revision committee of the United States Pharmacopœia since 1880 and

its chairman since 1901, died in Philadelphia on January 1, aged seventy years.

The death is announced of Professor G. P. Girdwood, professor of chemistry in McGill University. He was born in London in 1832 and took up medical practise in Montreal in 1864. From 1872 to 1902, he was professor of chemistry in the faculty of medicine.

W. J. E. Foakes, late chief government inspector of Explosives for Cape Colony, has died in London.

Tuberculosis and war were discussed at a national conference of experts in connection with the annual meeting of the board of directors of the National Jewish Hospital for Consumptives at the Hotel Savoy, New York, on January 13. Addresses were made by Jane Addams, of Hull House, Chicago; Dr. Herman M. Biggs, state commissioner of health; Colonel G. E. Bushnell, of the Surgeon-General's Department; Colonel D. U. Dercle, representing the Medical Department of the French Government; Dr. John H. Finley, commissioner of education of the State of New York, and Dr. Charles J. Hatfield, executive secretary of the National Association for the Study and Prevention of Tuberculosis.

A Ministry of Public Health and Social Welfare has been constituted for Austria with Dr. Baernreither as the first minister. It is to supervise the care of war invalids, to combat war diseases, and to centralize pre-existing, uncoordinated departments of public health and sociology. It is to have the care also of the dependents of fallen soldiers, infant welfare, housing and insurance.

In consequence of strong protests, the British War Cabinet will reconsider its proposal to take over the British Museum for the use of the Air Board. According to cablegrams to the press the *Times* prints an editorial and also many letters against the proposal. Other newspapers also raise a vigorour outcry against the appropriation of the museum, declaring it "preposterous," "a serious scandal," and an "unjustifiable act of vandalism." The *Manchester Guardian* says that the suggestion to take over the building is an incredible outrage, which should never be suffered while there remains a hotel, a private mansion, or, if need be, a royal palace that can be commandeered. Sir John E. Sandys, public orator in Cambridge University, has written a vigorous letter of protest. He pointed out that it would be impossible to remove more than a fraction of the valuable contents of the museum and that what was left probably would be damaged by ill-usage. Sir John also referred to the fire risk of the new occupancy, and, moreover, that the building, whose treasures are the envy of Germany, had not as yet been attacked from the air. He feared, however, that when the air board was installed there it would be regarded as the legitimate object of an enemy attack.

The reappearance of Encke's comet was reported on January 4 in a dispatch to the Harvard College Observatory from Copenhagen. The position was given as follows: Right ascension, 22 hours 59 minues 49 seconds; declination, north 3 degrees 17 minutes 35 seconds. The comet was observed by Professor Schorr of the Bergedorf Observatory on the evening of December 30.

The late G. F. Melville, an Edinburgh advocate, has made a bequest of about £250,000, the income of which is to be used ultimately for the care and cure of cancer under a special trust which he has established.

After the adjournment of the meeting of the Geological Society of America held in St. Louis, December 27 to 29, an excursion was conducted to the southeastern Missouri Lead District, under the direction of Professor W. A. Tarr, of the University of Missouri. The occurrences of the lead ore at Flat River were first studied, the party spending considerable time underground investigating the workings of the Federal Lead Company. Mine La Motte and the North American Mine in the vicinity of Fredericton were also visited. The party included Professors R. M. Bagg (Lawrence College), A. P. Coleman (University of Toronto), C. W. Knight (assistant provincial geologist of Ontario), E. H. Kraus (University of Michigan), T. R. Van Horn (Case School of Science), L. G. Westgate

(Wesleyan University), and W. A. Tarr (University of Missouri).

FEDERAL food administrators from thirty-eight states and from the District of Columbia and Hawaii and representatives from all the other states met in Washington on January 9 for a two-days' conference. Seventy-six delegates were at the meeting. They were addressed at the opening by Herbert Hoover, United States Food Administrator; by the Hon. David F. Houston, Secretary of Agriculture, and by several of Mr. Hoover's assistants. The administrators come to Washington every few months for conferences with members of the Food Administration, in order that a closer touch between the states may be established and to give each of them a clear understanding of the problems and conditions that must be met. The administrators were entertained at luncheon in the Food Administration Building and attended an informal dinner at the New Willard Hotel. Both the luncheon and dinner were in strict accordance with food-conservation rules. The following administrators were in attendance: Professor Alfred Atkinson, Montana; Edwin G. Baetjer, Maryland; Dr. Harry E. Barnard, Indiana; Braxton Beacham, Florida; Dr. Stratton D. Brooks, Oklahoma; J. F. Child, Hawaii; Alfred M. Coats, Rhode Island; Fred C. Croxton, Ohio; J. F. Deems, Iowa; Theodore C. Diers, Wyoming; William Elliott, South Carolina; Ralph C. Ely, New Mexico; P. M. Harding, Mississippi; James Hartness, Vermont; Charles Hebbard, Washington; Howard Heinz, Pennsylvania; Charles N. Herreid, South Dakota; Richard M. Hobbie, Alabama; Walter P. Innis, Kansas; Dr. Leon S. Merrill, Maine; Ralph P. Merritt, California; Charles E. Treman, New York state; Edmund Mitchell, Delaware; H. A. Morgan, Tennessee; Frederick B. Mumford, Missouri; Earl W. Oblebay, West Virginia; Henry A. Page, North Carolina; John M. Parker, Louisiana; E. A. Peden, Texas; George A. Prescott, Michigan; Fred M. Sackett, Kentucky; Robert Scoville, Connecticut; Dr. Andrew M. Soule, Georgia; Huntley N. Spaulding, New Hampshire; Gurden W. Wattles, Nebraska; Harry A. Wheeler, Illinois; Col. E. B. White, Virginia; Arthur Williams, New York City, and Clarence R. Wilson, District of Columbia.

THE *American Medical Journal* reports that the large collection of birds and mammals obtained as a result of the American Museum's Asiatic Zoological Expedition to China, conducted by Mr. Roy C. Andrews, has been placed on display just as it was received instead of first putting it through the processes of preparation. This collection comprises hundreds of skins of beautiful tropical birds, including newly discovered pheasants and peacocks. Small bright-hued jungle fowls are interesting as the ancestors of the present barnyard fowl which is playing such an important part in the food problem at the present time. For thousands of years this original type has existed in the heart of China. Unusual rodent forms are represented in the black flying squirrels, four feet long, together with huge rats, including the rare bamboo rat, scores of mice of strange appearance and odd variations of the mole. The chipmunks include several varieties hitherto undescribed by zoologists. Skins of serows and gorals, strange animals intermediate between the goat and the sheep, are also included in the exhibit.

UNIVERSITY AND EDUCATIONAL NEWS

AT New York University Hazen G. Tyler has been appointed professor of mechanical engineering; Dr. Edward K. Dunham, emeritus professor of pathology, has been appointed Herter lecturer, and Dr. John Charles McCoy has been appointed clinical professor of surgery. Dean Samuel A. Brown has been promoted from assistant professor of medicine to professor of therapeutics; Dr. Willis C. Noble, from lecturer on bacteriology to assistant professor of hygiene, and Dr. James F. Nagle, from instructor in medicine to clinical professor of medicine.

DR. L. C. GLENN, who was on leave of absence from Vanderbilt University last year in

the employ of the Sinclair Oil and Refining Corporation as geologist, has returned to the university this year, but retains his connection with the Sinclair companies.

Mr. L. A. Rumsey, former instructor in organic chemistry at Iowa State College, has been appointed head of the department of chemistry at Denison University, Granville, Ohio.

Dr. R. K. Strong, of the University of Chicago, has been appointed as professor of industrial chemistry at the Oregon Agricultural College.

DISCUSSION AND CORRESPONDENCE

RHYTHMIC PRECIPITATION

The abstract of Dr. H. N. Holmes's paper, read before the Kansas City meeting of the American Chemical Society, April 12, 1917, which appears in Science, November 2, 1917, calls for some discussion. He proposes a "new" theory to account for rhythmic precipitation bands. I have recently given a short account of some of the earlier work in the subject in a paper in the *American Journal of Science* for January, 1917, from which it is clear that the theory is comparatively old, having been suggested twenty years ago by Ostwald senior, and established six years later by Morse and Pierce.[1] Later workers have agreed with these pioneers, and recently I have shown that the rates of diffusion of the reagents have to be taken into account in explaining rhythmic precipitation, and that under certain conditions bands which become successively closer, or equally spaced bands, may be produced. Morse and Pierce also showed, fourteen years ago, that a gel is not essential to the formation of precipitates in separated bands, having obtained them in aqueous solutions. It is of interest and importance that Dr. Holmes has obtained them in loosely packed flowers of sulphur.

It might be asked what Dr. Holmes means by "crystalline banding of mercuric iodide." Is it possible that "banding of crystalline mercuric iodide" is meant? Again, it is difficult to understand what is meant by "a thickness of a few cubic centimeters," thickness usually being measured in one dimension, not in three dimensions.

I would take exception to the statement: "The color arrangement of agate is an excellent example of the phenomenon." It may possibly be an example of the phenomenon. I have not studied agates in sufficient detail to discuss the subject at this time, but such cursory examinations of agates as I have made have been sufficient to indicate that the offhand acceptation of agates as examples of rhythmic banding by precipitation within a medium of gelatinous silica is inadvisable. There are very few agates which are not susceptible of other explanation. Liesegang, in his "Geologische Diffusionen," after discussing agates as products of rhythmic precipitation within gelatinous silica, is careful to point out that he does not propose to apply this explanation universally.

It is unnecessary to state that the description of Dr. Holmes's experiments with silicic acid gels will be awaited with interest. From the partial account given in his abstract the experiments would appear to be along similar lines to those of Hatschek, and Hatschek and Simon.

J. Stansfield

Geological Department,
McGill University

[1] Morse, H. W., and Pierce, G. W., *Zeitschr. phys. chem.*, Vol. XLV., 1903, p. 589, or *Physical Review*, Vol. XVII., No. 3, September, 1903, p. 129.

GRAVITATIONAL REPULSION AND THE COMET

The results presented by the writer in a paper recently published by the Academy of Science of St. Louis[1] may be of assistance in explaining the behavior of the comæ and tails of comets. Twenty years ago Newcomb gave the following description in Johnson's Universal Cyclopædia.

> When a bright comet is carefully examined with a powerful telescope, a bow will sometimes be seen, partially bent around the nucleus on the side towards the sun. If watched from night to night, this bow will be found to expand from the nucleus, become diffused and finally lose itself in the nebulosity of the coma. . . . These bows seem to be

[1] *Trans.*, Vol. XXVIII., No. 5, November 8, 1917.

formed of hemispherical envelopes of vapor, which rise from the nucleus itself, dissolve themselves in the coma, and are gradually repelled from the sun so as to form the material of the tail.

The turning point in the motion of these dust particles which are repelled towards the sun may be thus defined. The gravitational repulsion of the nucleus, the gravitational attraction (or repulsion) of the sun, and the repulsion due to the pressure of light-waves, are balanced against each other. These dust particles are gradually dispersed into space. The radiation of negative corpuscles from the sun, superposed upon the other causes above mentioned, seems to furnish a full explanation of the phenomena of the comet.

FRANCIS E. NIPHER

BARITE IN GEORGIA

IN the Friday, December 21, 1917, issue of SCIENCE, on page 611, under the title of "Chemical industries of the United States," you quote from the annual report of Franklin K. Lane, Secretary of the Interior,

> Before the war 40,000 tons of barite were imported from Germany for the manufacture of lithopone. Now five companies are producing this article from deposits in Tennessee, Kentucky, Virginia and Missouri.

This quotation is incorrect in that over 50 per cent. of the barite produced in the United States comes from deposits near Cartersville, Georgia. There are three companies in the Cartersville district that have produced over 20,000 tons apiece during 1917, while the total output from this dictrict could be conservatively estimated at 75,000 tons during 1917. You do not mention that any barite at all is mined in Georgia, and I feel that this should be brought to the attention of the public, as it is an injustice to this mining district, as they are the largest producers of this mineral in the United States.

WILBUR A. NELSON

CARTERSVILLE, GA.

MANGANESE IN ALBERTA

MY attention has been directed to an article in SCIENCE, January 4, 1918, page 20, describing a large deposit of manganese occurring in the Cypress Hills, Alberta. Permit me to say, through the medium of your valuable magazine, that the Geological Survey has no information regarding a deposit of the nature described. During the summer of 1917 an examination was made by a member of the staff of the Geological Survey of a deposit of low-grade manganese in the Cypress Hills about 55 miles from Maple Creek and 15 miles from Govenlock station on the Canadian Pacific railway. Three samples gave on analysis 8.24, 18.45 and 17.59 per cent. of managanse. A shipment of 500 pounds of the material was tested in the Ore Dressing and Metallurgical Laboratories of the Mines Branch and the conclusion was reached that it is of too low a grade to be worked economically under present conditions.

WILLIAM MCINNES,
Directing Geologist

SCIENTIFIC BOOKS

Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species Inhabiting Tahiti. By H. E. CRAMPTON. *Carnegie Institution of Washington.* 1916.

This work has an interest for the student of evolution in any group, quite apart from its special interest to the conchologist. Such variable non-mobile land shells scattered widely among oceanic islands offer a field in many aspects most favorable for compilation of statistics bearing on speciation. Also, a very large series of material has been studied and adequately described and figured.

Evolutionary writers frequently attempt to balance an imposing structure of hypothesis on a few inadequate facts. The paper under discussion seems to have gone to the other extreme in laying the *Partula* variation almost entirely to the innate tendency to vary. The statement that "the originative influence of the 'environment' seems to be little or nothing" (p. 12) is perhaps justifiable, but that "isolation proves to be a 'condition' and not a 'factor' in differentiation of forms belonging to this genus" is weakened when we

read that "with only one exception, each group of islands has its own characteristic species which occur nowhere else.

"The same correlation between geographical and specific discontinuity is displayed by the species of the different islands of one and the same group for each member possesses distinct species not found in the others" (p. 11); and that the various varieties are confined within rather easily definable geographic limits.

It would seem that the isolation factor had been so taken for granted as to be overlooked. It has certainly not been the only, perhaps not a necessary, factor. For instance (p. 309), we find mention of "two absolutely independent varieties [of *P. otaheitana*], *rubescens* and *affinis*, which have almost identical geographical limits; yet they stand in the sharpest possible contrast to one another." A very intensive study of these two varieties would, in the reviewer's opinion, almost surely show some slight difference of habit, of adaptation to the same environment, otherwise being too far separate to interbreed freely, one of them should have crowded the other out.

Perhaps, the conclusion of the widest interest, if not of the greatest importance, is found in the following statement. "The evidence tends to prove that the dominant geological process in South Pacific regions has been one of subsidence, which has progressively isolated various mountain ranges previously connected, so that they have become separate island-masses, which, in their turn, have been subsequently converted into the disconnected islands of the several groups."

JOHN T. NICHOLS

AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK

SPECIAL ARTICLES

FURTHER EVIDENCE RELATIVE TO THE VARIETAL RESISTANCE OF PEANUTS TO SCLEROTIUM ROLFSII

DURING 1916 data were collected[1] which indicated that there is a marked difference in the susceptibility of peanut varieties to the attacks of *Sclerotium Rolfsii*.

The soil in the plots where the peanut rotation experiment is being conducted has been proven to be thoroughly infested with *Sclerotium Rolfsii*, and the Valencia variety has shown great susceptibility to the attacks of this fungus; therefore, at the writer's suggestion, the use of the Valencia variety for the rotation experiment was discontinued, and commercial seed of the Virginia Bunch variety was substituted for use in 1917. Plots one and three, each about one third of an acre in size, were planted for the 1917 test. Plot one had grown peanuts continuously since 1910, while plot three had grown peanuts in 1911 and 1914.

It was observed that some of the supposed Virginia Bunch plants had a procumbent habit of growth, and when these plants began to blossom the suspicion that they were of the Virginia Runner variety was confirmed. As these two varieties are supposed to be merely selections of erect and procumbent types of plants from the same original variety, the presence of the Virginia Runner plants in the 1917 plantings might be due either to a slight mixture of the commercial seed, or a failure of the Virginia Bunch variety to be in all cases well fixed.

The two plots were under observation until the crop was harvested, November 9, 1917. During this time the writer found one Virginia Bunch plant in each plot which had wilted, and examination disclosed the coarse, white mycelium of *Scelerotium Rolfsii* about the base of the stems, thus indicating that the wilting was due to this fungus, as had been proven in many cases in 1916.

The fact that none of the Virginia Runner plants wilted confirms the data collected in 1916 to the effect that this variety is practically immune to the attacks of *Sclerotium Rolfsii*.

The resistance of the Virginia Bunch variety in 1917 was much greater than in 1916, as shown by the fact that in 1916, out of a

[1] McClintock, J. A., "Peanut-wilt caused by *Sclerotium Rolfsii*," *Journal of Agricultural Research*, Vol. VIII., No. 12, pp. 441–448, March 19, 1917.

total of one hundred and thirty-two plants, six wilted; while in 1917, out of a total of more than seven thousand plants, on the same land only two wilted.

These data will possibly be of some value, especially to the Southern States, where the peanut promises to become a more important crop in the boll-weevil infested districts, and where *Sclerotium Rolfsii* has already become established as a serious parasite of numerous crops.

J. A. McCLINTOCK
VIRGINIA TRUCK EXPERIMENT STATION,
NORFOLK, VA.

THE BOSTON MEETING OF THE AMERICAN CHEMICAL SOCIETY. VII

Potash recovery from greensand and feldspar and by-products therefrom: H. W. CHARLTON. The process, stated briefly, consists in digesting greensand, feldspar, etc., with the requisite amount of lime and water at elevated temperatures and pressures. The alkali is brought into solution and recovered as a hydrate, and the solid material, which has undergone both chemical and physical change, is filtered off and employed as a binding material in the manufacture of brick, tile, artificial stone and other steam-hardened products. Possessing, as it does, self-cementing properties in addition to those induced by the steam-hardening treatment, it turns out materials which for strength and resistance to climatic conditions are superior to previously known steam-hardened products. Although the reaction may be applied to alkali-carrying silicates in general, it is believed that greensand is economically the most suitable, occurring, as it does, in unlimited quantities, obtainable without blasting or crushing and lying in stratified layers overlaid with a high silica sand. This is particularly fortunate as the overburden may be used with the resulting binding material in making brick, and the cost of mining is materially lessened. In the proportioning of the digestion mixture when using feldspar it is necessary to employ an equal weight or more of lime and eight times its weight of water, and to digest at pressures of from 200–250 pounds for from two to four hours. If the amount of water is reduced below this figure, the alumina in the feldspar appears to cause a reverting action. Fortunately this is not the case with greensand where the alumina is normally replaced by iron, and a double concentration can be employed. If lime is added in excess, there are no bad effects, as it is changed into a plastic sub-hydrate which in itself is a powerful binding material. It is undoubtedly true that the cementing material from a feldspar digestion is superior to that from greensand, but the cementitious properties of both are much superior to those now used in the production of steam-hardened products. Feldspar residue could be used in the manufacture of excellent face brick, whereas greensand residue would probably be better suited for the production of court or common brick, roofing, tile, drain tile, sewer pipe, fire-proofing, etc. Probably the most serious problem in the recovery of potash from feldspar is the separation of the soda. When employing greensand the almost complete absence of soda makes it possible to obtain a very pure caustic with one evaporation. Another objection to feldspar treatment is the almost invariable presence of alkali aluminates in the caustic liquor. It is found that there is not a trace in the greensand liquors. Although caustic alkali or a hydrated carbonate are the usual products of the recovery of the potash, other compounds may be easily formed as an end product. The same is true of the cementing material. Its use is not confined to the manufacture of brick. Other products such as tile, artificial stone, insulating material or stucco, are easily produced, and the choice depends on the market.

Some problems in the metallography of steel: H. M. BOYLSTON. (1) Banded structures in steel; their existence, cause and effect. Banded structure in nickel steel, in high manganese rifle-barrel steel, in shell forgings. Prevention and cure. (2) The hardening of high-speed steel and its relation to composition and performance. The Bellis microscopic test for determining best hardening temperature. Effect of carbon content. Effect of special elements. Streaky carbides. (3) The annealing of carbon steel castings. Results desired. Old methods. Present practise.

The effect of annealing on the electrical resistance of hardened carbon steels: I. P. PARKHURST. The object of the investigation was to anneal quenched steels over definite periods of time at constant temperatures. Five steels were determine the effect on electrical resistance of used varying in carbon content from 0.08 to 0.45 per cent. The temperatures used were 125° C., 175° C. and 250° C. The total periods of annealing varied from 90 to 190 hours. Results were plotted as time against resistance. Micro-photographs were made of the specimens during the

various stages of treatment. It was shown that while considerable variation in resistance could be produced by annealing, this variation was not accompanied by structural changes of a nature that could be easily detected under the microscope.

Thermophysics of zinc and its alloys: J. W. Richards. The author discusses some physical, particularly thermal, data which are lacking with respect to zinc and its chief alloys, brass and bronze, and calls attention to the great need of laboratory work to determine these constants. The data needed, such as vapor tensions at low temperatures, and latent heat of evaporation, are constants of nature, difficult to determine, yet of primary importance to the zinc industry if accurately determined and properly and intelligently used.

Recent developments in connection with the use of sulphur dioxide in hydrometallurgy: Edward R. Weidlein. The process developed by the author is based upon the precipitation of copper by means of sulphur dioxide. In precipitation, the solution is neutralized with lime and treated with sulphur dioxide until it has dissolved a percentage of gas equal to that of the contained copper. The precipitation of metallic copper ensues instantly when the solution is brought to a temperature of 160° C. under a pressure of 100 pounds. The mechanical arrangements are such that the processes of dissolution and precipitation are continuous. The copper assays, when melted, over 99 per cent. pure and contains oxygen as the sole impurity.

The importance of the flotation process in the metallurgy of copper: E. P. Mathewson. *Process revolutionary:* There is more ore handled daily by flotation than by any other non-ferrous metallurgical process. Prior to adoption of process the concentration losses were seldom less than 20 per cent.; now they are seldom over 8 per cent. Savings now so great that the so-called hold-up by owners of patents can not cripple the users of the process. *Process is a rule of thumb development:* The theory is now being worked out, but no wholly satisfactory theory has yet been evolved. Canadian users can afford to take chances on outcome of litigation, as they will only be compelled to pay reasonable royalties.

The theory of froth: Wilder D. Bancroft. Froth is a closely packed mass of bubbles having a cellular or honeycomb structure, the walls of the cells being liquid films. Froths are more stable, the more viscous the films; and the films can be made more viscous by adding solids.

Chemicals used in ore flotation: Oliver C. Ralston and L. D. Yundt. The use of certain chemicals in the flotation concentration of ores has been described and theories of the action of these chemicals have been explained. The use of chemical addition agents in ore-pulps during flotation is only in its infancy, and as the process is better understood operators will make greater use of chemical addition agents which will allow them to obtain the highest economic results. The possibilities of such applications are almost unlimited and it is probably along lines of this kind that some of the great advances in ore flotation will be made.

The selective action of cadmium salts on lead and zinc sulphides in flotation: M. H. Thornberry. The experiments so far completed show that the presence of cadmium salts practically stops lead sulphides from floating. The effect of these salts on zinc sulphides will be carried out in time to give results in the final paper.

Flotation experiments on zinc sulphide tailings, III.: W. A. Whitaker, S. F. Farley and H. P. Evans. (*a*) *The Effect of Certain Mixtures of Oils.*—A previous series of flotation tests carried out in this laboratory on a zinc sulphide tailing showed that the lighter wood distillates and certain vegetable oils displayed good selection for the mineral and yielded rich concentrates, while coal and wood tar mediums did not show such selection between mineral and gangue, but yielded high extractions. A series of tests was made in order to learn the effect of mixing a good "concentrating" medium with a good extracting medium, and of mixing certain lighter oils. (*b*) *The Effect of Organic Solvents.*—Solvents such as benzol, alcohol, kerosene, turpentine and gasoline were used with different oils in order to determine whether this method of emulsification would exert a favorable effect in flotation. The method was carried out under neutral, acid and alkaline conditions on tailings from the Joplin District. (*c*) *A Comparison between the "Mechanically Agitated" and "Pneumatic" Types of Flotation Machines.*—Several tests mentioned under (*a*) and (*b*) were made in machines of both types. The results obtained, as regards richness of concentrate and percentage extraction, were compared and plotted.

SCIENCE

FRIDAY, JANUARY 25, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME NEEDS OF ENGINEERING[1]

LET me remind you that the practise of our art is still empirical in that most fundamental matter, the strength of the materials which we use, their ability to resist the stresses to which we expose them. It will suffice to touch on two phases of this matter, that our reception tests are quiescent, though in many cases they should be kinetic, and that they do not determine the true resistance of the material even to relatively quiescent stress, as it is applied in many important services. Let us consider these two in series.

It should be an axiom that reception tests should represent the most trying service stresses, which in many important cases are kinetic, arising from impact, shock or very rapid application of stress. This is true of gun hoops, shells, rails, tires, axles, and many parts of motor cars, and of agricultural and other important classes of machinery. The fitness of such materials for enduring these kinetic stresses should be determined primarily by means of impact tests. For each service the severity of this impact should represent the greatest and most rapidly applied stress which is to be expected.

What would you say to using a hydraulic press to determine the ballistic resistance of armor plate or the resistance of a safe to a burglar's sledge? Yet it is only in degree that our present practise is less rational than this, and it is only because fa-

[1] Address of the Vice-president and Chairman of Section G, of the American Association for the Advancement of Science, Pittsburgh, December 28, 1917.

miliarity has dulled our sense of incongruity that we do not rebel against its irrationality.

Machines for determining quantitatively the resistance of steel to impact of any desired degree of violence have been on the market for about twenty years, and they have come into use to a considerable extent in Europe for reception tests, though even there they have not received a fraction of the attention which they deserve, so fully has habit blinded us to the irrationality of our present practise. These machines measure quantitatively the energy consumed in breaking a test piece under impact of given violence, and also the capacity of the material for plastic deformation under these same conditions.

It is pure empiricism to measure fitness for these kinetic conditions by applying a factor of safety to the results of quiescent tests. Not only must such a factor be a matter of guesswork, but that which suffices for certain materials is wholly insufficient for others. We know that certain steels, which we call "fragile," behave well under quiescent tests, but are very brittle under impact. A factor suitable for them would involve a great waste if applied to infragile steel, while one suited to infragile steel might lead to death and disaster if applied to that which is fragile. Unfortunately the fragile and infragile can not be distinguished by our present quiescent tests, though certain causes of fragility can be detected with the microscope. Under these conditions, unhesitatingly preferring waste to disaster, we adopt a factor suited for fragile steels. This in turn means that we load the community with the cost of a superfluity of material in that large majority of cases in which we use infragile steel, lest we invite certain disaster by our present neglect to take the simple precautions of using the impact test so as to detect fragility. To secure infragility by regulating the composition of the product and the process of manufacture is far better than nothing; but these precautions, which the buyer can enforce with difficulty if at all, should in his interest be supplemented by the direct and positive exclusion of fragile material by means of the impact test.

A like overloading occurs through our trying to provide for the shocks incident to these kinetic services by requiring great plastic deformability, which we currently call "ductility," in the shape of permanent elongation and contraction of area under quiescent tests. This provision at first seems wholly irrational, because these services imply no appreciable plastic deformation, so that we demand properties which will never be utilized. Neither guns, nor rails, nor tires deform plastically in use to an appreciable extent. The excuse is that to increase the ductility, even that determined quiescently, is to increase the power to endure shock. Unfortunately the shock resistance thus implied is far less in fragile steels than in infragile ones, so that in order to secure enough of it for the fragile steels which we may use unwittingly we specify a degree of ductility wholly superfluous in infragile ones. This superfluous ductility is very costly, whether it is got without sacrifice of strength by means of special heat treatment or composition, or, sacrificing unit strength, by using much more of a much weaker steel, following the principle that for given grade of steel, every gain of ductility carries with it a corresponding loss of strength. We could save this needless expense by using the impact test and thus detecting fragility, for then we could lessen the ductility which we exact to that needed for infragile steels.

It is beside the mark that for many uses, including some kinetic ones, more material is needed for rigidity than for strength,

and that here the teachings of the impact test would not lead to economy. That cast iron is strong enough for sash weights, flywheels, and bedplates does not prevent our heat-treating alloy steels for aeroplanes.

Turning to our second subject, my assertion that we do not determine the true resistance of our material even to relatively quiescent stress refers to fatigue strength, the resistance to stresses applied repeatedly. Of the four properties which we habitually determine, the elongation and reduction of area certainly throw little light on fatigue strength, nor can we expect much from the tensile strength, which represents the exaltation of the elastic limit induced by the plastic deformation after the initial elastic limit has been passed. This deformation can not be tolerated in hypo-elastic services, that is in those which demand that each member must retain its initial size and shape, and here the ability of the material to undergo the resultant exaltation of its elastic strength is useless, save as forming a basis for calculating the ductility from an additional point of view, through the elastic ratio, and thus supplementing the elongation and reduction of area as suggestions of impact resistance. How is it then with the fourth of these properties which we determine, the elastic limit?

Before answering this, it is well to refresh our conception that, because the innumerable ferrite and cementite grains of our steel lie with their slip planes inclined in every possible direction, and because the stresses are not distributed exactly evenly throughout the member or test piece, there is some one slip plane in some one grain that is less favorably disposed than any of the others towards the existing stress. That is the weakest spot in the bar. If we increase the stress gradually, slip occurs along that slip plane before anywhere else. The failure of this metal to bear its load tends to overload its neighbors. The stress which causes slip along this weakest plane is strictly speaking the true elastic limit, because this slip changes the dimensions of the bar permanently. Perfect elasticity, the power to return exactly to the initial dimensions, exists only below this limit of stress, which hence by definition is the elastic limit. That this first slip can not now be recognized and probably never can be affects this inference as little as our inability to see atoms and molecules interferes with our belief in their existence.

The elastic limit which we determine with our extensometers may, for clearness, be distinguished from the true elastic limit by calling it the "observed elastic limit." That is must needs recede as our extensometers become more sensitive and must thus approach the true elastic limit asymptotically, is clear.

If this stress which has caused the first incipient slip is released, the elasticity of the rest of the metal reverses the slip, and if the stress is quickly reapplied new slip recurs along this same plane, and so on with quickly succeeding applications of stress, according to our conception, which, moreover, holds that this repeated slipping back and forth causes local degeneration. Moreover, the overloading of the adjoining parts by the slip along this one slipping plane leads them in time to begin slipping, so that after many repetitions of the cycle this degeneration extends through so much of the section that the remaining sound metal is unable to sustain the stress, and hence breaks. This leads naturally to the conception that the true elastic limit is the fatigue strength.

Without insisting on the accuracy of this picture, it certainly helps us to understand why our present observed elastic limit does not measure the fatigue strength, and stimulates us to determine much earlier

stages of slip, in the hope that as we approximate the true elastic limit we shall thereby approximate the fatigue strength as well.

Two methods which might lead to much closer approximations than can be expected from refining our direct measurement of the changes of dimension by means of extensometers, are the thermal and the magnetic.

In the thermal method, the fatigue strength is determined as the stress of which rapid repetitions cause a detectable rise of temperature, supposed to represent the heat evolved by the friction along the first slipping planes. This method owes its attractiveness to our conception that the thermo-electric measurements of temperature seem intrinsically capable of greater sensitiveness than the direct measurement of length. On further examination the method loses some of its promise, for though a slip over a very minute area might yield enough heat to be detected if it lay at the very outside of the specimen, if it were deep-seated it might not, because the heat in working outwards would spread itself over a very large area of surface, and this would lessen correspondingly the actual rise of temperature. Hence if we took the stress which causes the first detectable rise of temperature as our best approximation to the fatigue strength, our results might vary greatly with the position of the first slipping area.

The magnetic method would determine the fatigue strength as the least stress of which repeated applications cause a detectable change in the magnetic properties. The developments of this method which are now occurring at the Bureau of Standards deserve our most careful attention.

From the fact that the ability to endure many millions of repetitions of stress is much less than the observed elastic limit, and from our natural explanation that the difference represents some form of progressive degeneration under indefinitely repeated stresses, we naturally infer that when the repetitions are in the hundreds of thousands a like but smaller degree of this same degeneration occurs. From this in turn we infer that even when the repetitions are only in the thousands this degeneration may occur, though in correspondingly smaller amount. From this we generalized that the gap between the observed elastic limit and the safe working load should increase as some function of the number of repetitions of stress to be expected during the life of the member, and we ask whether this increment should not be considered even in designing bridges, and whether it should not increase with their expected life and the frequency of the passage of trains.

A natural question which arises in this connection is whether, as regards fatigue strength, that part of the elastic limit of steel which is caused by a low finishing temperature in rolling is valid or fictitious and removed during the exposure to repeated stresses. The great life of piano wires, strained very severely and exposed to a repetition of stress with each sound wave, and of suspension bridge wires, both of which owe much of their elastic strength to cold deformation in the shape of wire drawing, is reassuring. An interesting case is that of piano wire, which is credibly reported to have sprung back into a helix when cut after fifty-four years' service, showing that it retains even through its enormous number of repetitions of stress the bending given it in coiling it.

Struggling as we are for our national existence, these pale thoughts move us hardly more than the remembrance of his last month's rent stirs the shipwrecked swimmer in his landward struggles.

It is well to ask ourselves frankly how we come to be in this peril to which our minds revert irresistibly. How is it that we and our allies, excelling the Teutons in both the ponderables and the imponderables, in material resources, in wealth, and in population, on one hand, and with immeasurably higher ethical standards on the other, yet can point to no clear evidence of victory? We know that we excel in organizing power. We know that they have no product of organization comparable with our industries of the Ford motor car, the Bell telephone, the Ingersoll dollar watch, the Eastman Kodak, or the United States Steel Corporation. We know that the organization of our transportation is of a higher order of merit than theirs. We know that in these three years the British have made even a better war organization than the forty-four years since Sedan have given Germany. How comes it then that though we are incomparably stronger, richer, and more capable, we are yet in danger of defeat, of national overthrow, of becoming a German satrapy, a second Belgium or Poland? Do we not know that our disadvantage lies in our political system, and that in this struggle for existence it is not showing itself clearly the fittest for survival? Have we not lost sight of this terrible law of the survival of the fittest, not the fittest ethically, or spiritually, or intellectually, but the fittest to destroy competitors physically? What are the ethics of the snake, the tiger, or the hyena that they have survived in this struggle? The bloodthirsty buccaneers were neither the ethical nor the spiritual betters of the Aztecs and Incas. The Romans were the inferiors of the Greeks, yet they overthrew them, and in turn were overthrown by the barbarians. Fitness for survival must be physical.

It is well to ask ourselves frankly whether we have not been living in a fool's paradise. We have rejoiced in the merits of our political system, in the kind of men and women which it has bred, through opening every career to all, through stimulating each one to strive to his utmost in his chosen path. In our natural rejoicing have we not shut our eyes obstinately to its defects? Have we not refused to see that our system necessarily impels those in office to direct their energies towards their own re-election rather than towards the welfare of the state, to please and propitiate the electors rather than to direct and inspire them, to tell them what it is their wish rather than their true interest to hear, and thus in effect to substitute the temporary opinions of the majority, unfamiliar with state matters, for the vision of the born leaders as the determinant of state policy? We rejoice that our system educates the voters in statecraft, that it broadens their horizon, that it breeds strong units, but we have been too weak, too self-complacent to remedy its defects of leaving those units uncemented, so that they form what may be likened to a friable sandstone, a whole which, in spite of being composed of extremely strong units, is yet incoherent.

The state has as a most important duty this strengthening of the individual units, but that does not justify neglecting the equally important duty of perpetuating itself. We make a fetish of our political system and regard its designers as inspired. They certainly were most intelligent and patriotic, and builded well considering how little actual experimental evidence they had to guide them. But we should not hold their system sacrosanct. Indeed, one essential part of it, the electoral college, soon proved wholly impracticable, impotent to do its work of selecting a president, and became a mere registrar of decisions reached by others. This promi-

nent failure shows what their system really was, an attempt by frail human beings, with very little to guide them, to devise the most difficult of all human institutions, the government of a country. The corruption of our municipal governments is another clear proof of the fallibility of our forefathers, for all these faults result from the environment which they created, and mean that it misfits human nature in these respects.

Naturally erring in the direction of overguarding against the governmental fault from which they were smarting, irresponsibility and consequent tyranny, they devised a government which, as we now see, is so weak as to be terribly helpless, indeed in danger of an impotence which may prevent it from defending itself efficiently against aggressors.

It is this weakness that has put us in our present peril. When Germany began her attempt to conquer the world, her purpose was evident to every broadminded man, and must have been foreseen clearly by many of our political leaders. It was indeed pointed out repeatedly by contributors to the newspapers, and was neither denied nor questioned, but only ignored, with the result, which was clearly inevitable and as clearly predicted, that she has been able to fight her enemies in detail. A government made strong by the fundamental law of the land would have exposed this peril to the voters, and we should not have had for allies an impotent Russia, a crushed Belgium, Servia and Rumania, and a sorely pressed France and Italy. Indeed, it was the known weakness of our system that made the war possible.

A curious contradiction is that the weakness of the government is matched by a tying of the peoples' hands. Not only are we debarred from selecting our rulers and confined to choosing between candidates administered to us by irresponsible organizations, but once we have chosen both we and our representatives are impotent to remedy an error in choice, by compelling a change in administration, as is done with great profit in Britain, France, and elsewhere. Frankly, we should face squarely the fact that our governmental system, as the first of the great experimental democracies, was the work of apprentices, and we should strive earnestly to mend it as soon as we have passed our present frightful peril.

The system and checks and balances, in weakening the people, their representatives, and the administration alike, has put the power taken from them into the hands of irresponsible organizations, the political machines.

I criticize none. The errors of individual officers, from the constable to the President, flow from our system itself. It is the system that needs betterment.

Henry M. Howe

FOOD-BORNE INFECTIONS[1]

Gastro-intestinal disturbance traceable to some food eaten shortly before is a common occurrence and is indeed part of the experience of many persons. Not long since, the majority of such attacks were declared due to "ptomain poisoning" and were deemed to be sufficiently explained by this designation. It was believed, though never, it must be confessed, on very good evidence, that the foods responsible for the trouble had been kept too long or under improper conditions and had undergone bacterial decomposition or spoiling. This decomposition was supposed to have resulted in the formation of ptomains, a

[1] Address of the Vice-president and Chairman of Section K, Physiology and Experimental Medicine, American Association for the Advancement of Science, Pittsburgh, December, 1917.

name given by Selmi to certain basic compounds formed in the later stages of protein disintegration. Interest in the ptomains was especially stimulated by the work of Brieger, who isolated and stuided (1882–1888) the properties of many of these bodies.

Confidence in the sanitary significance of ptomains has been shaken by many facts. For one thing, ptomains are formed in the later stages of protein decomposition, and by the time they are present, the organoleptic evidences of decomposition have become pronounced. There is little doubt that food containing ptomains would be almost invariably condemned by the senses as nauseating and unfit for use. On technical grounds numerous criticisms have been made with respect to the methods used for isolating and extracting ptomains and for determining their clinical effect. Perhaps the principal reason, however, for the decline in the belief that ptomains have any important share in the production of food poisoning has been the discovery that in many instances the responsibility can be placed definitely upon other factors. Those outbreaks of food poisoning that have been most thoroughly investigated have been found to be due not to the use of spoiled food containing ptomains but either (1) to the presence of true bacterial toxins comparable to the toxins of the diphtheria and tetanus bacilli and not to be regarded as the simple products of decomposition, or (2) to infection with specific bacteria borne in or upon the implicated food article.

Poisoning from bacterial products in food, when it occurs at all, seems to be due to the accidental and occasional presence of toxigenic microbes which give rise to specific toxins. Little is known about the conditions under which the relatively rare toxigenic bacteria find their way into food stuffs. In the best-known example of this type, the severe poisoning due to the products of *Bacillus botulinus*, certain facts seem to indicate a regional distribution of the microorganisms. In this country 17 of the 22 recorded outbreaks have occurred in California. There is no record of a single case in Great Britain.[2] All told, demonstrated instances of food poisoning due to bacterial products are not very numerous.

On the other hand, the careful investigation of food-poisoning outbreaks has brought to light a very large number of instances of apparent poisoning which are in reality cases of infection with some pathogenic microorganism. The distinction is practically important. The measures that need to be taken to prevent infection are of a different nature from those designed to prevent the use of food containing the products of bacterial growth.

There are still many questions about the use of spoiled foods that need settlement. Some foods such as cheese and sour milk that are loaded with the products of microbic activity appear to be used with impunity, but while we are not yet able to specify with precision the differences between harmful and harmless bacterial action, there can be little doubt that the almost universal preference for fresh food containing as few bacteria as possible rests on a sound physiological basis.

Food-borne infections are essentially of two separate and quite independent classes:

[2] A number of obscure points in botulism intoxication remain to be cleared up. The discoverer and leading student of the biology of the botulism bacillus, Van Ermengem, states that the spores are destroyed by 15 minutes' heating at 85° (185° F.) or by 30 minutes' at 80° (176° F.), but Dickson (*Jour. Amer. Med. Association*, 1917, 69, p. 966) has recently reported observations indicating much greater heat resistance. Further investigation of this important question is urgently needed.

those in which the pathogenic organisms are present in the food at its origin, without human intervention; and those in which the food has become contaminated from human sources during the process of preparation, transportation or serving.

The contamination of food with disease germs on its way from source to consumer may occur through direct contact either with a person suffering from disease or a convalescent or a healthy carrier. From such an individual the specific pathogens may be conveyed to the food by mouth-spray or by contaminated fingers.

It probably does not often happen that such contamination is brought about by a person seriously ill with a specific infection except in the initial or later stages of the malady. The incapacitating effects of most infectious diseases tend to prevent the active participation of the patient in marketing or serving food. Mild or atypical cases, however, of such diseases as typhoid fever are a source of danger, and instances are on record where food-borne infections have originated from definitely affected persons. From the public-health standpoint infection from this source is important and must be guarded against with great vigilance.

In a variety of human infections convalescents constitute an important source of food contamination. As is well known, pathogenic organisms may be present in the nose or throat, in the intestines or in other organs, for some time after clinical recovery has taken place. It is possible in diphtheria and some other infections to determine with a high degree of certainty when the specific germs finally disappear from the body, but unfortunately this knowledge is not always taken advantage of in actual practise. There is reason to believe that in typhoid fever, for instance, patients frequently are released from the hospital while they are still discharging typhoid bacilli from the bowels or bladder. The hospital authorities often do not inform their clients or themselves on this point, and the germ-bearing convalescent is not warned of the danger to family and associates which his condition involves. In some infections the length of persistence of the specific germs can not be determined by present methods, and consequently only rule-of-thumb methods of quarantine are practicable. As matters stand, it is plain that food-handling by those recently convalescent from any infectious disease is always to be avoided; knowledge of this fact should be spread as widely as possible.

It is not necessary to dwell at length on the significance of the true "carrier" in food-borne infections, since in recent years the nature of the disease-carrier problem has been given wide publicity. The term disease carrier is commonly applied to those in whom the specific germ persists far beyond the usual period of convalescence and also to those who harbor a disease-producing microbe, although they have apparently never suffered from a clinical attack. It is evident that this latter group constitutes a peculiarly insidious source of infection, since the possession of disease-conveying power is often entirely unsuspected by the persons affected, and is only revealed by investigations following an actual outbreak.[3] The majority of the

[3] A remarkable instance of a typhoid carrier has been reported by Jundell (*Hygiea*, Festband, 1908; editorial, *Jour. Amer. Med. Assoc.*, 1909, 52, p. 388). The grandmother, 79 years old, of a large family was found in 1908 to harbor typhoid bacilli and had apparently been responsible in her lifetime for some thirty-two cases of typhoid fever in members of her family and in servants and other persons in the household. The period during which this carrier was capable of conveying infection apparently extended over fifty-four years,

"healthy carriers," however, are known to have been recently in contact with patients or convalescents.

Efforts to keep down the number of food-borne infections due to the contamination of food by sick persons, convalescents or carriers are therefore mainly directed to placing the ordinary food manipulations in the hands of healthy persons and of those who have not been recently in contact with the sick. This task is somewhat simplified by the rather limited number of diseases likely to be conveyed through such agencies. The chief food-borne infections hitherto traced to human contamination are typhoid fever and the various paratyphoid infections. To these must be added certain infections transmitted in milk which are rarely, if ever, conveyed in other food-stuffs. Outbreaks of diphtheria, scarlet fever and streptococcus sore throat due to milk have been reported in considerable numbers, but foods other than milk probably seldom serve as the vehicle of these diseases. In the majority, if not in all, of these cases, the specific germ enters the milk directly from human sources. It is probable, however, that in some instances a secondarily infected cow must be held responsible. It is theoretically possible for the bacillus of human tuberculosis to be transmitted by food, but evidence of the frequency of such transmission is not readily forthcoming. Even the contamination of milk by a tuberculous milker is not easy to prove. Since it is almost impossible to trace most cases of tuberculosis to their origin, any precise evaluation of source of infection in this disease is at present out of the question. Technical difficulties, however, should not be allowed to override the application of analogies drawn from other diseases. It seems entirely reasonable to suppose that milk and other foods can become contaminated in the course of their collection or handling by a person discharging human tubercle bacilli. In the recent examination in New York City of 1980 food-handlers, 10 cases of active tuberculosis were found. The agency of flies in bringing about the contamination of food both with tubercle and typhoid bacilli must also be taken into consideration.

1854–1908. The disease was confined strictly to this one family, and the neighborhood was free from typhoid fever during all these years.

It can not be forgotten that there is a possibility of the multiplication of pathogenic bacteria in food. In general, microorganisms pathogenic for man do not increase freely outside the human body, and when discharged into the air, water or soil, quickly perish. But in many foods conditions obtain very much like those in the artificial culture media used in laboratories. If such foods become contaminated with pathogenic bacteria, a considerable increase in bacterial numbers may occur. In point of fact, it has been observed that multiplication of this sort does take place. There are many instances where the incriminated food, when fresh, gave rise to little or no injury, but after standing 24 hours or less without visible signs of decomposition produced numerous cases of illness. Especially significant is the large number of outbreaks in which such foods as meat jellies, meat pies, salads and made dishes generally have been inculpated. A very large proportion of the recorded outbreaks has been traced to foods that have been prepared for the table and then allowed to stand before being eaten, or that have kept over to a second or third day as remnants after the first serving. Cooking, so far from surely destroying all bacteria, may in some cases provide a favorable temperature for bacterial multiplication, as in the celebrated California

outbreak of 93 cases of typhoid infection due to a dish of baked spaghetti. Here it was found by subsequent experiment that the degree of heat reached in the interior of the dish was an incubating rather than a sterilizing temperature. Milk, which is an excellent culture medium, is a food particularly liable to become dangerous through the multiplication of bacteria. The mixing of milk from many farms at a central station tends to disseminate any contamination present through the whole supply. One typhoid carrier on a single farm may therefore lead to the contamination of a large volume of raw milk and to an extensive epidemic. The pasteurization of milk offers a satisfactory method of meeting this danger.

Besides the various modes of direct contact there are more roundabout methods of food contamination from human sources of infection. One possibility is the transmission of typhoid infection by vegetables grown on land fertilized by night soil. The practise of manuring truck gardens with human excreta is not unknown in this country and is believed by some to be increasing. Melick[4] has shown that typhoid bacilli may remain attached for several weeks to lettuce and radishes grown in contaminated soil, a period quite sufficient for the maturing of these vegetables. He also showed that the bacilli are not removed from the surfaces of the vegetables by the ordinary methods of washing used in preparing such foods for the table.

The second type of food-borne infection, that in which the food itself is contaminated at its origin and does not simply pick up contamination en route to the consumer, is especially exemplified in the case of certain infections of the ordinary food animals. Food plants are not attacked by any microorganism pathogenic to man, with perhaps the single exception of the coconut palm, in which a disease called bud-rot is said to be caused by a variety of *B. coli*, an organism usually harmless but under some conditions slightly pathogenic for man. The rather numerous species of bacteria that cause the diseases to which the common garden vegetables are subject are none of them, so far as known, pathogenic for man or other animals. On the other hand, many food animals suffer from bacterial infections that may be communicated to man.

Milk is probably the animal food that serves most commonly as the vehicle of this type of infection. It has been definitely established that the bacillus of bovine tuberculosis may be present in the milk of a diseased cow and that the use of such milk in a raw state is a source of human infection, particularly in young children. Milk from diseased animals may also produce infection in foot-and-mouth disease, in Malta fever (goat's milk) and in some other diseases. In many cases the condition of the animal is such as to give ample warning, in others the danger is not so readily apparent. Adequate pasteurization of the milk is a safeguard against this mode of infection as well as against infection with milk contaminated from human sources.

Other food products originating from diseased animals may contain pathogenic bacteria. A noteworthy number of outbreaks of meat poisoning have been traced to the use of meat from animals ailing at the time they were slaughtered, and later discovered to have been definitely infected. Bacilli of the paratyphoid-enteritidis group are found in a large proportion of these cases, both in the meat of the diseased animals and in the organs or excreta of the persons affected. This class of food infections is of special interest, since in their

[4] *Jour. Infect. Dis.*, 1917, 21, p. 28.

sudden onset and acute gastro-intestinal *symptoms* they present the characteristic features of what is popularly supposed to be ptomain poisoning. They are in reality genuine infections with pathogenic bacilli. Cattle and swine are apparently particularly prone to infection with bacteria of this group, and by far the larger number of meat-poisoning epidemics are due to meat from these animals. The meat of sheep is rarely implicated. It is noteworthy also that a large proportion of the recorded meat poisoning outbreaks are due to raw or imperfectly cooked dishes. Sausages, especially such as are made of raw meat and eaten without cooking, have been incriminated in a significantly large number of cases. Internal organs like the liver and kidneys are more apt to contain bacteria than the masses of muscle commonly eaten as "meat." Unfortunately, inspection of the meat may not give any warning of the presence of pathogenic bacteria. Meat in appearance quite normal to the trained eye of the veterinary has been known to give rise to a meat poisoning outbreak. Neither is it always practicable by a system of live-animal inspection to prevent the marketing of meat from infected animals. Thorough cooking is probably the best means of preventing this as well as all other forms of food-borne infection.

While paratyphoid seems to be the most common form of meat-borne infection, there is a possibility that other kinds of pathogenic bacteria present in the bodies of diseased food animals may sometimes be transmitted to man in meat or meat products. The possible conveyance of tuberculosis in this way has been thoroughly investigated, and it is now pretty generally agreed that in most civilized countries the danger of contracting tuberculosis from meat is not serious. Under any ordinarily careful system of inspection tubercle-infected carcasses are not likely to be marketed without restriction, and the thorough cooking to which meat is commonly subjected is a further and efficient safeguard. It is apparently true also that very large numbers of tubercle bacilli are necessary to produce infection of human adults through the alimentary tract. Altogether the concurrence of favorable conditions for the transmission of tuberculosis by meat is probably rare. Bacilli of the "bovine" type are seldom found in adults. Although theoretically possible, there does not seem to be any convincing evidence that cases of tuberculosis have actually resulted from the use of meat.

In several acute diseases of food animals caused by bacilli pathogenic for man the possibility of human cases being food-borne is even more remote than in tuberculosis. Anthrax is not at all likely to be transmitted through food. Many diseases, such as hog cholera, swine erysipelas and pleuropneumonia of cattle that affect various domestic animals are not known to be transmissible to man in any way. Conversely, typhoid fever and Asiatic cholera are not diseases from which the lower animals suffer, and consequently are not infections that can originate with any food animal.

The chief infections therefore that are known to be due to food infected at its source are those—mainly meat-borne—caused by the group of paratyphoid-enteritidis bacteria and those resulting from the use of infected milk. The methods for preventing food infection are not those of simple inspection of food products. It has been questioned whether the amount of disease prevented by the ordinary methods of food inspection is at all commensurate with the outlay. Chapin[5] in considering the

[5] "The Relative Values of Public Health Procedure," *Jour. Amer. Med. Assoc.*, July 14, 1917, 69, p. 90.

relative values of health work has estimated the value of food sanitation (exclusive of milk) at 10 on a scale of 1,000. He adds:

> The small value here assigned may arouse protest, but who will argue that the laboratory is not five times as important, or baby nurses eight times as important, or the direct control of contagious diseases ten times as important as is food sanitation?

The prevention of food-borne infection at present can be best effected by (1) thorough heating, including especially milk pasteurization; (2) employment of healthy persons for food preparation and serving; (3) examination of food animals at or shortly before slaughter; (4) general cleanliness of surroundings where food is prepared or served; (5) use of food in a fresh condition.

Edwin O. Jordan
University of Chicago

SCIENTIFIC EVENTS

THE GENERAL MEDICAL BOARD OF THE COUNCIL OF NATIONAL DEFENSE

The general medical board of the Council of National Defense held a regular stated meeting in Washington on January 13. The meeting was an unusually enthusiastic one, even despite the fact that not a few members caught snowbound in the blizzard en route were unable to reach Washington on schedule time. The following members responded to the roll call: Dr. Franklin Martin, member of the advisory commission of the council, chairman; Dr. W. F. Snow, secretary; Surgeon General William C. Gorgas; Surgeon General William C. Braisted; Rear Admiral Cary T. Grayson; Dr. Victor C. Vaughan; Dr. William H. Welch; Dr. Thomas S. Cullen; Dr. Edward P. Davis; Dr. Robert L. Dickinson; Dr. Philip Schuyler Doane; Dr. Joseph Rilus Eastman; Dr. John G. Clark; Dr. Duncan Eve, Sr.; Dr. S. McC. Hamill; Dr. W. H. G. Logan; Dr. Fred Bates Lund; Dr. John D. McLean; Dr. Rosalie Slaughter Morton; Miss M. Adelaide Nutting; Dr. Albert J. Ochsner; Dr. Hubert A. Royster; Dr. J. Bentley Squier; Dr. George David Stewart, and Dr. W. C. Woodward.

For the Army, Colonel Deane C. Howard, dealt at length with the recent perturbing epidemics of measles and pneumonia, but furnished the comforting news that both of these epidemics were at the present moment under adequate control. The admission rate for the past week was lower than it had been in some time, and it was hoped that both morbidity and mortality would in the very near future show a corresponding drop. Colonel Howard also pointed out the satisfactory status of the troops in regard to the venereal problem.

Admiral William C. Braisted, for the Navy, furnished assurance that the health conditions were all that could be desired, considering the factor of seasonal disease. The Navy also has been troubled with pneumonia, and was not a little concerned regarding the question of meningitis. Admiral Braisted expressed great gratification over the fact that his request for a meningitis segregation camp in Florida had been granted. It is hoped to isolate in this camp all meningitis carriers, and to care for them until they are once again safe and serviceable individuals.

Dr. Joseph Schereschewsky, for the Public Health Service, submitted a report detailing the health conditions in the various cantonment zones and what the Public Health Service has been doing to maintain these various zones in a state of good health.

Dr. T. Clark, who reported for the Red Cross, described the establishment of the four sanitary units that are cooperating with the other sanitary forces of the government in a most worthy attempt to aid in the maintenance of a high tone of public health, in addition to cooperating with those officials concerned in the direct maintenance of a low morbidity rate in the Army and Navy proper. Dr. Clark made it perfectly plain that the Red Cross was glad and willing to expend all that was legitimately necessary to accomplish any worthy purpose. If more than the present appropriation called for were needed, it would be forthcoming. If less were needed, there would naturally be a curtailment.

Major William F. Snow reinforced the earlier remarks of Colonel Howard on the prob-

lem of venereal disease in the Army, pointing out how easy it was to misinterpret statistics as applied to this topic, and emphasizing the need for continuous effort in the hope of maintaining the present standard of low morbidity.

For the Army General William C. Gorgas expressed satisfaction with the present state of health in the Army, although he emphasized the importance of the winter epidemics of measles, pneumonia and meningitis. He cautioned against the possible mistake of referring the pneumonia epidemics solely to the cold weather, and was inclined, rather, to feel that this was only an indirect cause. As a result of winter the men naturally segregate and are more closely housed. This may be the important factor, and not the cold weather itself. The general pointed out how this certainly is the case in smallpox, which is also a cold-weather disease, although not directly referable to winter itself, and how, during his service in the Tropics, he lived through epidemics of pneumonia among the troops much more severe than those that the Army health authorities are at present combating.

Major M. G. Seelig explained the principles involved in the daylight saving propaganda, and to aid in the passage of this bill through the House, the following resolution was approved:

Resolved, That the general medical board of the Council of National Defense indorse the plan of daylight saving and lend its influence in securing the passage of a law directed toward this end.

Dr. S. McC. Hamill reported for the committee on child welfare. This committee is made up of the following members: Dr. S. McC. Hamill (chairman), Dr. Fritz Talbot, Dr. H. T. Price, Dr. Frederick L. Hoffman, Dr. J. Whitridge Williams, Miss Hannah J. Patterson, Mrs. Josiah E. Cowles, Dr. Grace L. Meigs, Mrs. Stanley McCormick, Miss Ella Phillips Crandall, Miss Julia C. Lathrop, Mr. Philander P. Claxton and Miss Dorothy Pope. They reported that it was decided for the present, to center the attention of the committee on the preparation of a program covering the welfare of the mother, provision of intelligent obstetrical care, and the protection of the life and health of the child during its first two years. The program of the committee in full covers all forms of child-welfare work, placing special emphasis upon maternal and infant mortality, and in this relation centering on details of birth registration, prenatal, obstetrical and infant care. Dr. Hamill presented a resolution directed toward securing the closer cooperation of the medical schools of the country along lines of child-welfare work. This resolution was referred to the executive committee.

Dr. Francis D. Patterson, chief of the division of industrial hygiene and engineering, Pennsylvania department of labor and industry, spoke on the subject of reconstruction, detailing at length the experience of England in reconstructing, rehabilitating, and reeducating her disabled men. Dr. Patterson pointed out the four distinct lines of effort essential in solving the problem of reconstruction. 1. Medical and surgical treatment of the injury and disease. 2. Vocational training. 3. Securing of employment. 4. Maintenance of medical supervision of the man after he has gone back into industry. He also emphasized the necessity of more or less planning of work in educating employers up to the point of recognizing the need of cooperation on their part in the proper utilization of the reconstructed soldier.

Dr. Joseph Schereschewsky made a report for the committee of industrial surgeons, outlining their aims as follows: To provide against unnecessary human waste in industry and society during war. To offset the drain on industry of man power caused by the raising of military forces. To meet the need for greatly increased production. To avoid preventable deaths and disabilities from accident and disease. To restore to full producing power in the shortest possible time sick and injured workers. To increase output by maintaining workers in good health. To provide healthful places in which to work. To provide healthful homes and communities in which to live. To meet shortage of medical service induced by military needs.

Dr. Edward P. Davis, of Philadelphia. sub-

mitted a report advocating the establishment of an auxiliary medical service corps. This corps is intended to utilize the services of those men who, either by age or physical disability, are disqualified from receiving a commission, but who nevertheless are potentially of service to the country and who greatly desire to render this service. The method of election to the medical service corps as recommended by Dr. Davis was as follows: The applicant is to apply by letter to the secretary of the state governing body, who shall mail to the applicant a printed form which, when properly completed, will give full information concerning the applicant and enable his proper classification according to training and special fitness. The name of the applicant, with information concerning him thus obtained, shall be submitted to the committee on elections. The final acceptance of a candidate for membership in this organization is to be by the national governing body. The committee considers it of the utmost importance that members of this organization be suitably designated, and for this purpose recommends that a brassard with appropriate insignia be provided.

Dr. A. Homer Smith reported on the drug situation, detailing important data regarding chemical glassware, digitalis, alkaloids used in ophthalmic practise, novocaine, mercury, and other drugs. He pointed out the urgent need of supply and conservation, and pleaded for complete coordination of all branches of the government on all subjects pertaining to drug and chemical need.

Dr. Philip S. Doane, of Chicago, who has been assigned to duty with the Shipping Board, submitted a report outlining the medical activities carried on in connection with this board. The Shipping Board has at present under its supervision 170,000 men, and it is expected that this number will reach 350,000 within the year. Dr. Doane detailed how these men were being looked after, both as regards the conservation of their health and the treatment of accident and disease prevalent among them, as well as the provisions made for their general welfare, amusement and comfort.

For general surgery, Dr. J. Bentley Squier, of New York, submitted interesting data on the progress that is being made in classifying the various surgeons of the country. These men were classified in accordance with data that they furnished on their own questionnaire, but in addition to this, the surgical committee, in order to code the men in such fashion as to furnish real, valuable data to the government, obtained information by personal investigation both of the personality and of the professional qualifications of the men constituting the various surgical groups of applicants.

Up to date, 21,000 applicants for the Medical Research Corps have been coded in such fashion that at a moment's notice the medical authorities of the War Department may secure almost any desired type of information regarding any individual in the service of waiting for commission.

Miss Ella Phillips Crandall, of the nursing committee, reported on the efforts being made by this committee toward maintaining the nursing standard at a high level, while at the same time securing an adequate number of nurses. This committee has also made inquiries into the question of suitable provision for the nursing care of returned soldiers and sailors in the reconstruction hospitals. This latter work, of course, is being done in close cooperation with those divisions of the War Department and of the Red Cross which have similar work in mind and hand.

Major John D. McLean, reporting for the committee on states activities, announced that the committee had formulated and secured the approval of the Surgeon General's Office for rules of procedure for medical advisory boards.

Dr. Rosalie Slaughter Morton reported for the committee of women physicians that this committee now had on its register the names of 1,796 women physicians, or approximately 33 1/3 per cent. of all the women physicians registered in the United States. It is hoped that these women physicians may be used to help meet the need of internes, laboratory workers, radiographers, and anesthetists. The women physicians of the country are enthusi-

astic and ready for service along these lines, and truly feel that their services would be of aid in winning the war.

For the medical advisory boards, Major McLean stated that all the governors' aides have been appointed, and have been received with hearty accord. It has been the universal report that the services of these governors' aides have been invaluable, and in many instances the governors have requested permission to attach the aides to their offices for the period of the war.

Dr. Victor C. Vaughan submitted the final report of the meeting, emphasizing the necessity of close cooperation between civilian authorities and military authorities in the regulation of health matters concerning both these branches. In the state of Michigan, where very close cooperation exists, infectious diseases occurring in the civilian population necessitates immediate report to the military authorities in the nearby cantonment by telephone or telegraph. This enables the military authorities to institute efficient quarantine against any particular quarter in the state where communicable disease is known to be present. Dr. Vaughan expressed the hope that, were it practical and feasible, close cooperation would be established between all civilian and military health authorities throughout the country.

UNITED STATES DYESTUFFS

THE United States is the only country that has succeeded in establishing a successful dyestuff industry since the war began, and it has been found that American dyes are as good as German dyes, according to a report made by the Bureau of Foreign and Domestic Commerce. Formerly importing annually as much as $10,000,000 worth of aniline dyes alone, this country exported during 10 months of last year $12,500,000 worth of dyes to 21 foreign countries, and exports are growing rapidly. The largest purchaser last year was Britain, which used over $3,000,000 worth of dyes in 10 months.

In view of her situation as to dyes, Britain is congratulating herself on the recent capture of the recipes of 257 German dyes. It is said that these were secured with great danger and difficulty by British textile firms, assisted by the British foreign office. Professor Philip B. Kennedy, commercial attaché of the American Embassy in London, who cabled the news to the United States Bureau of Foreign and Domestic Commerce, says that it is reported that all the recipes have been tested in Switzerland by F. M. Rowe, of the Manchester School of Technology, and certified by a British consular officer. The recipes will be given to the British government, which will establish a dye industry in England.

Delegations from the greatest British dye firms and from those in Switzerland are now in this country to obtain information about the American dyestuff industry, with a view to coordinating their efforts with this country's in covering the world markets after the war.

In this connection it is regarded as particularly significant that some 200 manufacturers of dyestuffs from all parts of the country planned to meet at the Chemists' Club in New York on the twenty-second and twenty-third of January for the purpose of forming a national association. This association when formed will pay particular attention to the high quality of American dyestuffs and the standardization of colors.

Throughout this meeting it is hoped that some coordinated plan may be reached by American manufacturers to cover the foreign field for American dyestuffs in the future.

Among the developments in American-made dyestuffs has been the perfecting of vegetable dyes and mordants. One which has served a particularly useful purpose has been the osage orange dyes, first exploited by the Department of Agriculture, and developed for utilization as khaki dyes for uniform cloth.

THE BOARD OF NATURAL RESOURCES AND CONSERVATION OF THE STATE OF ILLINOIS

THE last session of the State Legislature of Illinois adopted a Civil Administrative Code which provided for a very complete reorganization of the civil administration of the state government in order to secure greater econ-

omy and efficiency. The following departments were created: Finance, agriculture, labor, mines and minerals; public works and buildings, public welfare, public health, trade and commerce and registration and education. A director of each was appointed by the governor. Provision is made for the preparation of a state budget in connection with each department, and in this and in many other ways it is expected that increased economy and efficiency will be secured in the administrative work of the state.

The Department of Registration and Education has charge of the work previously under the Board of Education of the state of Illinois, and the boards of trustees of the state normal schools. It also exercises the powers and duties vested by law in the boards of examiners for physicians, dentists, pharmacists, etc., and supervises the work of the Natural History Survey, Geological Survey and Water Survey of the state. In exercising the latter duty the director of the department is assisted by a Board of Natural Resources and Conservation, which acts through five or more subcommittees, each of which is composed of the director of Registration and Education, the president of the University of Illinois, or his representative, and the expert adviser, specially qualified in each of the fields of investigation covered by the surveys.

The first meeting of the full Board of Natural Resources and Conservation was held at the University of Illinois on Saturday, December 15, 1917. There were present, Director Francis W. Shepardson, who presided at the meeting, Dean David Kinley, representing the president of the University of Illinois, Professor T. C. Chamberlin, Professor John M. Coulter, Mr. John W. Alvord, Professor William Trelease and Professor W. A. Noyes, members of the board, and Professor S. A. Forbes, Mr. Frank W. DeWolf, Professor T. E. Savage, Mr. G. C. Habermeyer and Mr. W. T. Monfort, representing the Natural History Survey, the Geological Survey and the Water Survey.

Professor W. A. Noyes was chosen secretary of the board. The following divisions were organized in accordance with the provisions of the Civil Administrative Code of the State of Illinois:

1. The State Natural History Survey Division, which includes the duties formerly exercised by the state entomologist and the State Laboratory of Natural History,
2. The State Geological Survey Division, and
3. The State Water Survey Division.

The board was organized to include the following subcommittees:

(*a*) A subcommittee in the Natural History Survey Division, including the director, the representative of the president of the University of Illinois, Professor S. A. Forbes, *chief*, Professor John M. Coulter.

(*b*) A subcommittee in the Natural History Survey Division, including the director, the representative of the president of the University of Illinois, Professor S. A. Forbes; *chief*, Professor William Trelease.

(*c*) A subcommittee in the Geological Survey Division, including the director, the representative of the president of the University of Illinois, Mr. Frank W. DeWolf; *chief*, Professor T. C. Chamberlin.

(*d*) A subcommittee in the Water Survey Division, including the director, the representative of the president of the University of Illinois, Mr. W. T. Monfort, Professor W. A. Noyes.

(*e*) A subcommittee in the Water Survey Division, including the director, the representative of the president of the University of Illinois, Mr. G. C. Habermeyer, and Mr. John W. Alvord.

Professor S. A. Forbes was appointed chief of the Natural History Survey Division, Mr. Frank W. DeWolf, chief of the Geological Survey Division, and Professor Edward Bartow, chief of the Water Survey Division.

The chiefs of the respective surveys were requested to prepare a brief statement of the character of the work done by similar scientific surveys and bureaus in other states, and to recommend directions in which the work of our surveys should be developed.

Reports were received from the chiefs of the respective surveys with regard to the work which is now in progress and which has been completed during the past year.

SCIENTIFIC NOTES AND NEWS

At the annual election for officers of the American Philosophical Society, held on Jan-

uary 5th, 1918, the following were elected to serve for the ensuing year: *President,* William B. Scott; *Vice-Presidents,* Albert A. Michelson, George Ellery Hale, Joseph G. Rosengarten; *Secretaries,* I. Minis Hays, Arthur W. Goodspeed, Harry F. Keller, Bradley Moore Davis; *Curators,* Charles L. Doolittle, William P. Wilson, Leslie W. Miller; *Treasurer,* Henry La Barre Jayne; *Councilors,* to serve for three years, Bertram B. Boltwood, Ernest W. Brown, Francis B. Gummere, Herbert S. Jennings.

OFFICERS of the Geological Society of America for 1918, were elected at the recent meeting, as follows: *President,* Whitman Cross, Washington, D. C.; *First Vice-President,* Bailey Willis, Stanford University, Cal.; *Second Vice-President,* Frank Leverett, Ann Arbor, Mich.; *Third Vice-President,* F. H. Knowlton, Washington, D. C.; *Secretary,* Edmund Otis Hovey, New York; *Treasurer,* E. B. Mathews, Baltimore, Md.; *Editor,* Joseph Stanley-Brown, New York; *Librarian,* Frank R. VanHorn, Cleveland, Ohio; *Councilors* (1918–1920), Joseph Barrell, New Haven, Conn., R. A. Daly, Cambridge Mass.

THE officers of the Brooklyn Entomological Society elected at the annual meeting on January 10 are as follows: W. T. Bather, *president;* W. T. Davis, *vice-president;* Chris. E. Olsen, *treasurer;* J. R. de la Torre Bueno, *recording secretary;* R. P. Dow, *corresponding secretary. Publication Committee:* R. P. Dow; *Editor,* C. Schaefer and J. R. de la Torre Bueno.

PROFESSOR R. A. SAMPSON has been elected president of the Scottish Meteorological Society.

THE portrait of Professor Thomas C. Chamberlin, head of the department of geology at the University of Chicago, referred to in a recent issue of SCIENCE, will be presented to the university at the June convocation.

MAYOR HYLAN has appointed Dr. J. Lewis Amster, of the Bronx, health commissioner of New York City, to succeed Dr. Haven Emerson. Dr. Amster is a graduate of the Cornell University Medical School, class of 1902.

DR. R. W. SHUFELDT, of Washington, D. C., having made application for duty on the active list of the Medical Corps of the Army, has been assigned by General Gorgas to the Army Medical Museum. His work will consist in modernizing the present collection and preparing for the incoming medical and surgical material from the front.

THE following committee on the supply of organic chemicals for research during the war has been appointed by the American Chemical Society: E. Emmet Reid, chairman, Roger Adams, H. L. Fisher, J. W. E. Glattfeld, W. J. Hale.

AT the ninth annual meeting of the Amercan Phytopathological Society a movement was started which indicates that plant pathologists are not merely ready but determined to transform their assets and resources into war energy. In order that crop production may be increased by a more concerted effort than ever before put forth to stop the enormous leaks due to plant diseases, a War Emergency Board of seven members was created. The members of the board with the regions which they represent and the special lines of activity which they will supervise are as follows: *Chairman,* H. H. Whetzel, Cornell University, for the northeast, College and Extension Education; F. D. Kern, the Pennsylvania State College, for the central east, Man-power Census and Publicity; H. W. Barre, Clemson College, for the south, Southern Problems and Needs; G. H. Coons, Michigan Agricultural College, for the central states, Fungicides and Machinery, Supplies and Prices; E. C. Stakman, University of Minnesota, for the great plains, Emergency Research; H. P. Barss, Oregon Agricultural College, for the west, Western Problems and Needs; G. R. Lyman, U. S. Department of Agriculture, Plant Disease Survey, and Crop Loss Estimates.

VILHJALMUR STEFANSSON, the arctic explorer, according to Captain A. Lane, who arrived on January 15 at Fairbanks, Alaska, from the Arctic Ocean, bringing direct news from the explorer, was preparing to make a 300-mile dash over the ice north and west of the western Canadian Arctic coast during the

summer of 1918, in search of more new land. Stefansson, he said, intended to leave his present base in April and hoped to reach Wrangel Island, off the northern Siberia coast, in July or August. He planned to spend the 1918–19 winter on the island and end his explorations by sailing through the Behring Strait to Nome, Alaska, in 1919.

New Year honors in Great Britain, as reported in *Nature*, include: *K.C.B (Civil Division)*: Mr. A. D. Hall, F.R.S., secretary of the Board of Agriculture; Sir George Newman, principal medical officer to the Board of Education. *C.B. (Civil Division)*; Mr. F. L. C. Floud, assistant secretary to the Board of Agriculture. *Baronet:* Professor James Ritchie, Irvine professor of bacteriology, University of Edinburgh. *C.I.E.:* Mr. P. H. Clutterbuck, Indian Forest Service, chief conservator of Forests, United Provinces. *Knighthoods:* Mr. W. N. Atkinson, who has contributed largely to a knowledge of the dangers of coal-dust in mines; Dr. J. Scott Keltie, editor of *The Statesman's Year-Book,* and for many years secretary of the Royal Geographical Society; Dr. A. Macphail, professor of the history of medicine, McGill University, Montreal. In addition a large number of medical men have received honors for services rendered in connection with military operations in the field.

The lecture arrangements at the Royal Institution include the following: Professor J. A. Fleming, a course of six experimentally illustrated lectures, adapted to a juvenile auditory, on "Our useful servants: magnetism and electricity"; Professor W. M. Flinders Petrie, three lectures on Palestine and Mesopotamia—discovery, past and future; Professor Arthur Keith, three lectures on the problems of British anthropology; Dr. Leonard Hill, two lectures on (1) the stifling of children's health, (2) the climatic adaptation of black and white men; Sir R. T. Glazebrook, two lectures on the National Physical Laboratory; Sir Napier Shaw, two lectures on illusions of the atmosphere; Professor W. J. Pope, two lectures on the chemical action of light; M. Paul H. Loyson, two lectures on the ethics of the war; Sir J. J. Thomson, six lectures on problems in atomic structure. The Friday meetings will commence on January 18, when Sir James Dewar will deliver a discourse on studies on liquid films. Succeeding discourses will probably be given by Professor J. Townsend, Professor A. S. Eddington, Principal E. H. Griffiths, Professor A. G. Green, Professor E. H. Barton and Sir J .J. Thomson.

At the annual meeting of the Washington Academy of Science Dr. W. H. Holmes, of the U. S. National Museum, gave an address on "Man's place in the cosmos as shadowed forth by modern science."

A series of illustrated lectures dealing with science in relation to the war will be presented before the Washington Academy of Science during the present year. The first address of this series was given by Major S. J. M. Aul, of the British Military Mission, on "Methods of gas warfare," on January 17.

Mr. W. C. Mason, British imperial entomologist, died at thirty-three years of age on November 28, at Zomba, Nyasaland, of blackwater fever.

Professor C. Christiansen, professor of physics in the University of Copenhagen from 1886 to 1912, died on December 28, aged seventy-four years.

UNIVERSITY AND EDUCATIONAL NEWS

The bond issue of $1,000,000 voted by the legislature for the University of Tennessee has been sold and it is expected that the money will be immediately available.

The Carnegie Corporation will defray the expense of repairing the buildings of Dalhousie University, Halifax, which were damaged by the explosion on December 6. It is estimated that the amount necessary for repairs will be about $20,000.

Miss E. C. Talbot, of Margam, has presented to University College, Cardiff, an endowment of about $150,000 for a chair in preventive medicine. The first occupant of the

chair is to be nominated for election by the council by an expert board, of which Sir Wm. Osler is chairman.

AT the request of the federal government a free course in wireless telegraphy will be given at Bowdoin College. Professor Charles C. Hutchings and Professor Rhys D. Evans are to be in charge of the course.

DR. RAYMOND PEARL, biologist in the Maine Agricultural Experiment Station, and at present at the head of the statistical department of the United States Food Administration, has been appointed head of the department of biometry and vital statistics in the new school of hygiene and public health of the Johns Hopkins University.

DR. PHILIP A. SHAFFER, of Washington University, has been called to the national service. He has been succeeded by Dr. A. Canby Robinson, associate professor of medicine.

MR. ANDREW BOSS has been appointed vice-director of the Minnesota Experiment Station in addition to his present duties.

DR. C. H. SHATTUCK, recently head of the department of forestry at the University of Idaho, has accepted an appointment as professor of forestry in the University of California.

DISCUSSION AND CORRESPONDENCE

A SUGGESTION TO MORPHOLOGISTS AND OTHERS

IN the course of a year I look over a good many zoological papers on different topics outside of my own work—papers on genetics or the many aspects of embryology or ecology —and I am impressed with a general carelessness which exists among the writers on one point which probably seems unimportant to many of them but which to me seems of very considerable moment. The point is that very few of them give the name of the taxonomist who identified the species with which they have been working, nor do they indicate the preservation of typical material of the adult form so that the specific identification can be tested at any time.

Confusion has already resulted from this lack, and more will come. In many cases very great uncertainty exists as to the exact species with which the writer was working. If I were to write a paper in which the name of a beetle was given, my accuracy would be attested by the fact that I inserted, in parenthesis, "Determined by Schwarz" or "by Casey" or "by Fall," or, if it were a Protozoan, the same thing would happen if I inserted in parenthesis "Determined by Calkins," or, if it were a cactus, "Determined by Rose" or "by Trelease," or if it were a fly, "Determined by Knab" or "by Aldrich" or "by Johnson" or "by Malloch" or "by Parker" or "by Townsend." Such a statement as this would at once set at rest any question of accuracy, and would at the same time indicate the probable place at which representative specimens could be found in case of accident to the author of the paper or in case he should not himself preserve such material.

I have never done any embryological work, and in the recent work on chromosomes and the like I do not know how important it is that specific identification should be made of the forms studied; it may be entirely unimportant, if the genus is all right. But knowing, for example, that there are more than fifty species of *Drosophila* in the United States, it gives me an idea of inexactness when I see so many of these recent genetic papers, having to do with this genus, in which no species is mentioned. The writers seem to be entirely indifferent on this point.

Beginning with Howard Ayres's well-known paper "On the Development of *Œcanthus niveus* and its Parasite Teleas," in which he writes in one place of teleas as "a parasitic Ichneumon fly" and in another as one of the "Pteromalidæ," a paper which was awarded the Walker Prize for 1883, and concerning which it must be said that no true teleas has ever been reared from *Œcanthus* eggs,[1] and extending down to the present day, hundreds

[1] It is quite possible that the parasite which Ayres had was *Polynema bifasciatipenne* Girault, a species belonging to an entirely different family —the Mymaridæ.—L. O. H.

of papers have been published with almost equal lack of precise and attested knowledge of the identity of the form treated.

Of course some workers are more careful than others. E. B. Wilson seems to me to be a man who wishes to know exactly what he is working with. The same may be said for J. T. Patterson and for S. I. Kornhauser and others, but on the whole I think that this suggestion is worth while and I hope that it will appeal to many.

L. O. Howard

SCIENTIFIC BOOKS

The Anatomy of Woody Plants. By Edward Charles Jeffrey. University of Chicago Press, Chicago. October, 1917. With 306 illustrations. Pp. x + 478. Price $4.

This work, by the well-known professor of plant morphology in Harvard University, has been expected with much interest. The expression in the Preface, "Woody or so-called vascular plants," suggests that the two terms are synonymous, and, as a matter of fact, herbaceous forms are by no means neglected, though special prominence is given to the woody types, in accordance with the author's belief in their primitive nature.

Great stress is laid throughout on the supposed "Canons of Comparative Anatomy" formulated in Chapter XVII. It is even stated in the Preface that "any conclusions not in harmony with them have ordinarily not been considered" (with certain exceptions). This at once indicates the highly deductive character of the treatment, though the word "induction" is often used. The book, in fact, is essentially an able exposition of the views of Professor Jeffrey and his school; it will therefore be read with the most advantage by those who are in a position to read critically.

The general plan of the book is as follows: After a short chapter on the cell, we come to the tissue-systems. Next follows a chapter on wood in general, succeeded by four on the secondary wood and one on the phloem. The epidermis and the fundamental tissues occupy Chapters IX. and X. Then we have a chapter on the definitions of the organs, succeeded by three on the root, stem and leaf, respectively. Then follow two chapters, which it is a welcome surprise to find in an anatomical textbook, on the microsporangium, and on the megasporangium and seed. We then arrive at the important Chapter XVII., which lays down the author's "Canons of Comparative Anatomy." The arrangement of the next twelve chapters is systematic, from the Lycopodiales to the Monocotyledons. Chapter XXX. is an anatomical structure and climatic evolution; Chapter XXXI. treats of the evolutionary principles exhibited by the Compositae, and the last chapter is devoted to anatomical technique. The arrangement involves a certain amount of repetition, which, however, serves to bring out the points on which the author desires to lay special stress.

In defining the tissue-systems the author returns to Sachs's old divisions, the epidermal, fibrovascular and fundamental systems. The stele, so prominent as an anatomical unit in the work of the last quarter of a century, thus disappears; it is rarely mentioned and is not to be found in the index. This striking reversion in terminology is intimately connected with the author's theory that the pith is of common origin with the cortex and so does not belong to the central cylinder.

Much attention is given to the wood (especially the secondary wood) as this is the tissue for which the best fossil evidence is available; The libriform fibers are derived from tracheides, not from parenchyma as Strasburger held. Evidence is given also for the origin of xylem-parenchyma and of the so-called medullary rays from tracheides, and some excellent new figures of Lepidodendroid structure are furnished, in support of this view.

The statement (p. 49 and elsewhere) that tangential pits are absent in Palæozoic woods, is erroneous; they have long been described in *Pitys antiqua* and also occur in *Mesoxylon multirame* and doubtless in other species. In Chapter VII. there is an excellent comparative account of xylem-vessels in Gnetales and Angiosperms.

The epidermis is said to be of "relatively slight phylogenetic interest." Yet the stoma is probably the most conservative organ of plants.

The common term *medullary* rays is repeatedly condemned, on the ground that their relation to the pith is only a "semblance," due to obsolescence of the primary wood. This may be true, but the relation is of very old date, for it was already well established in the Calamites and some of the Cycadofilices. From the author's point of view the wide ray is a compound one, derived from the aggregate type of ray; the vascular bundles were not originally separate, and the statements of Sanio and Sachs as to the bridging over of the primary gaps by interfascicular cambium are rejected. They are, however, true, as a description of the facts, and hold good for the young Calamite as well as for more modern plants.

On the general question of the relation of herbaceous to arboreal types, it may be pointed out that there is no proof that our existing herbaceous Lycopods came from arboreal ancestors; the herbaceous *Selaginellites* was contemporary with the arboreal Lepidodendreæ. The siphonostele is held to have primitively possessed phloem on the inner as well as the outer surface. This type of structure, however, is rare among Palæozoic plants.

In the chapter on the Microsporangium the author adopts the view that the higher plants arose from forms like the thallose Liverworts, and quotes Bower's "Origin of a Land Flora" in support of this theory. No mention is made of Professor Bower's subsequent change of view.

The "Canons of Comparative Anatomy" which the author insists on are three in number—Recapitulation, Conservative Organs and Reversion. The doctrine of recapitulation in the development of the individual of the history of the race is well known, though no longer accepted without question. The author points out that *negative* evidence is of little or no value, but doubts may arise as to what testimony *is* negative; in a pine-seedling, for example, short-shoots are absent, but foliage-leaves on the main stem are present.

Among conservative organs the leaf is first cited, and then the reproductive axis. The present writer is given the credit for the latter idea; it belongs rather to Solms-Laubach, but neither generalized the conclusion, which was confined to the peduncles of Cycads. Floral axes are subject to modifications of their own, and are not necessarily conservative. As regards the root, the primary structure is no doubt highly conservative, but it does not follow that the same is true of its secondary modifications.

The word "reversion" is used in a peculiar sense, for certain effects of wounding, believed by the author and some others to be reminiscent of ancestral characters. This doctrine has hitherto been employed only in support of certain controversial opinions, and has not yet been adequately subjected to impartial criticism.

The worst of all such "canons" is that every writer applies them as suits his individual views, and treats inconvenient cases as exceptions.

In the systematic part of the book we first come to the author's well-known division of the higher plants into Lycopsida, without, and Pteropsida, with leaf-gaps in the vascular ring, a classification widely accepted, though it is now realized by many botanists that Sphenophylls and Equisetales have little in common with the Lycopod group.

The author's doctrine of the cortical origin of the pith is applied even to the Lycopods, where the evidence seems peculiarly unfavorable to this interpretation. It is a pity that the exact developmental processes involved are not more clearly explained.

The author's views on the evolution of the Osmundaceæ are well expounded, and a strong case made out, which would have been more convincing if the facts on the other side, brought forward by Kidston and Gwynne-Vaughan, had been dealt with.

The lower seed-plants are divided into Archigymnospermæ, including Cycadofilicales, Cycadales, Cordaitales and Ginkgoales, and

Metagymnospermæ consisting of the Conifers and Guetales. It is well point out that *Ginkgo* forms a link between the two main divisions. The long chapter on Coniferales is chiefly devoted to an exposition of the author's well-known view of the primitive position of the Abietineæ, and especially of *Pinus*, and the derivation of the ancient Araucarineæ from that group. This hypothesis is maintained with great ingenuity, in the face of much inherent improbability. The opposite view of the direct derivation of the Araucarineæ from their immediate Palæozoic predecessors, the Cordaiteæ, has been considerably strengthened by the work of Boyd Thomson and Burlingame.

The view, maintained by Wieland and his followers, of an affinity between the Bennettitales and the Angiosperms, is rejected. In this connection it may be pointed out that we have no actual proof that fertilization in *Bennettites* was by spermatozoids, as the author assumes.

The chapter on Herbaceous Dicotyledons is important, for it sets forth in detail the author's theory of their derivation from arboreal ancestors, a view which is well worthy of consideration. The author believes that the fresh and vigorous herbaceous vegetation will tend in future to supplant the forest trees; he has no such hopes, however, for the Monocotyledons, which he acutely remarks (p. 198), may be said to represent the second childhood of the vascular plants. "This group seems to have reached such a high degree of specialization that it will probably in the long run entirely disappear and be replaced by new derivatives of the still plastic dicotyledons" (p. 416). Such a consummation, however, is not likely to be reached while man remains dominant.

In the chapter on anatomical structure and climatic evolution, the question of annual rings is considered. While the author finds no such rings in Cordaitean wood from Prince Edward Island (Lat. 46° 30′) he believes that they are present in contemporary wood from Lancashire (Lat. about 53° 30′). The difference of latitude seems too small to be significant, and most appearances of annual rings in Carboniferous woods from any source are fallacious.

Chapter XXXI. is on a special subject, the evolutionary principles exhibited by the Compositæ, and is chiefly concerned with the somewhat narrow question of the distribution of oil-canals.

The concluding chapter is on anatomical technique, including the sectioning of coal and photomicrographic methods. On all these subjects the author is an acknowledged expert, and his counsels will be of the greatest value to practical workers.

The index might perhaps have been made fuller with advantage. No references are given in the book; the accumulation of references often becomes a burden, but a few would have been of service to the reader as a guide to his future studies.

In the present notice, attention has often been directed to points which seem open to criticism, or on which there is much difference of opinion. These divergences of view in no way detract from a high estimate of the great interest and complete originality of Professor Jeffrey's remarkable work.

The illustrations, as one would expect in a book by this author, are abundant and excellent.

D. H. S.

SPECIAL ARTICLES

ON THE SERIES IN THE ULTRA-VIOLET FLUORESCENCE OF SODIUM VAPOR

In two papers[1] published by Professor J. C. McLennan an account of the extension of Professor Wood's iodine vapor spectrum into the ultra-violet is put forth. Professor McLennan has not only proved that the resonance spectrum can not be obtained in the violet, but has also proved "that we have to do here with a case of ordinary fluorescence where Stokes's law is followed and where fluorescence is stimulated by the light from any one of a number of wave-lengths of a limited portion of the spectrum." In this case the fluorescence spectrum begins at λ4600 and extends to λ2100,

[1] J. C. McLennan, *Proc. Roy. Soc.*, LXXXVIII., p. 289; XCI., p. 23.

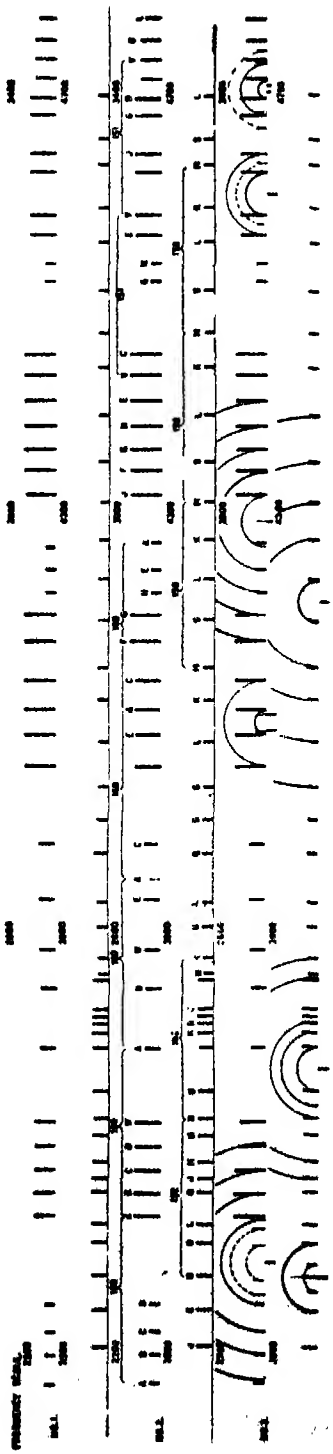


FIG. 1.

while the absorption region begins at λ2100, has a maximum between λ2000 and λ1900 and extends to λ1800.

The uranyl salts can also be stimulated by light of a wide range of wave-lengths and in the main Stokes's law is followed, although the fluorescence and absorption regions overlap. Like Professor McLennan's spectrum, the spectra of the uranyl salts appear to be unaffected by the mode of excitation, and while both spectra have been carefully tested for resonance, both have failed to show the phenomenon. For the above reasons it was thought that possibly the spectrum of the iodine vapor could be resolved into series of the same simple type as those found in the uranyl salts. If the wave-lengths of Professor McLennan's bands are converted into frequency numbers and plotted it is easy to discover series having constant intervals. Spectrum No. 1 in Fig. 1 shows the bands without any attempt at classification. It will be noted that the spectrum is in two sections because of its great length.

Professor McLennan notices several groups of bands which are spaced approximately 20 units apart. Such groups are present at $1/\lambda = 2400$ and at $1/\lambda = 3100$, but the series designated in spectrum No. 2 of Fig. 1 possesses much longer intervals. In this plot the members of the same series are given the same letter, and in addition a few have also been designated by long brackets. Such series as *A*, *V*, *N* and *M* are given brackets and the average value of the interval placed over the bracket. Here, as has so often been observed in the study of the uranyl spectra, a given series has a constant interval, but the various series have slightly different intervals. The value assigned to series *A* is 160, but this is an average value for the series, the actual intervals being given under Series *A* in Table I. as varying between 161 to 159 units. If the reader inspects the other series he will observe that the differences are generally unequal, but show no systematic deviation from a mean value. There are a few gaps in the series which may be caused by the presence of an exceedingly strong mercury line in the region

or by the dimness of the fluorescence. The fluorescence bands were located by reference to the strong lines of the mercury arc which served as the source of excitation.

TABLE I

Bands Arranged in Series of Constant Intervals

Series	λ	1/λ	Δ(1/λ)
A......	4608	2170	
	4290	2331	161
	4015	2491	160
	......	......	161
	3555	2813	161
	3365	2972	159
B......	4550	2198	
	4250	2353	155
C......	4505	2220	
	4210	2375	155
	......	......	158
	3725	2685	157
	3520	2841	156
	......	......	154
	3175	3150	155
D......	4452	2246	
	4170	2398	152
	3925	2548	150
E......	3800	2632	
	3585	2789	157
	3395	2946	157
	3220	3106	160
	3065	3263	157
F......	3475	2878	
	3290	3040	162
G......	3445	2903	
	3268	3060	157
	3107	3219	159
	2960	3378	159
	2825	3540	162
	......	......	157
	2594	3855	158
H......	3420	2924	
	3245	3082	158
	3090	3236	154
	2946	3394	158
	......	......	157
	2697	3708	157
J......	3315	3017	
	......	......	162
	2993	3341	162
	2853	3505	164
	2727	3667	162
	2612	3828	161

Series	λ	1/λ	Δ(1/λ)
L.....	2883	3469	
	2760	3623	154
	......	......	153
	2545	3929	153
	2450	4082	153
	2360	4237	155
	2277	4392	155
	2195	4556	164
	2129	4697	141
M.....	2715	3683	
	......	......	156
	......	......	157
	2408	4153	157
	2320	4310	157
	2237	4470	160
	2162	4625	155
N.....	2799	3573	
	2685	3724	151
	2580	3876	152
O.....	2900	3448	
	2774	3605	157
Q.....	2737	3654	
	2622	3814	160
S......	2476	4039	
	2382	4198	159
	2300	4348	150
	2218	4509	161
	2148	4655	146
U.....	2667	3750	
	2560	3906	156
V.....	3195	3130	
	3047	3282	152
	2915	3431	149
W.....	4130	2421	
	3870	2584	163
K.....	2628	3805	
	......	......	158
	2426	4122	159
	2340	4274	152
	2254	4437	163
	2179	4589	152

An argument against arranging the bands in series of constant intervals as outlined lies in the fact that nine of the nineteen series have less than four members present. The remaining ten series have five or more bands present, however, and it is worthy of note that the system is sufficiently universal to include all but three or four of the bands. The independence of the series is remarkably good—rarely

TABLE II

Bands Grouped around Mercury Lines (in Frequency Numbers)

Mercury Lines	Fluorescence Bands	Differences
	2170	+117
	2198	+ 89
	2220	+ 67
	2246	+ 41
	2255*	+ 32
	2268*	+ 19
2287		0
	2303*	− 16
	2319*	− 32
	2331	− 44
	2353	− 66
	2375	− 88
	2398	−111
	2759	+ 41
	2789	+ 11
{ 2793 { 2808		0
	2813	− 13
	2841	− 41
	2878	+114
	2903	+ 89
	2924	+ 68
	2946	+ 46
	2972	+ 20
2992		0
	3017	− 25
	3040	− 48
	3060	− 68
	3082	− 90
	3106	−114
	3263	+ 40
	3273*	+ 30
	3282	+ 21
3303		0
	3323	− 20
	3332*	− 29
	3341	− 38

Mercury Lines	Fluorescence Bands	Differences
	3540	+ 81
	3559*	+ 12
3571		0
	3584*	− 13
	3605	− 34
	3667	+104
	3688	+ 88
	3724	+ 47
	3737*	+ 34
	3750	+ 21
3771		0
	3791	− 20
	3805	− 34
	3814	− 43
	3855	− 84
	3876	−105
	4039	+177
	4082	+184
	4122	+ 94
	4153	+ 63
	4198	+ 18
4212 4220		0
	4237	− 21
	4274	− 58
	4310	− 94
	4348	−132
	4392	−176

* Geissler tube lines.

does a member of one series serve as a member of another series. It is possible to arrange many of the bands in series of shorter intervals, for at $1/\lambda = 2793$ and $1/\lambda = 2798$

and $1/\lambda = 2992$ intervals of 90 units are present, at $1/\lambda = 3304$ intervals of 106 units, and at $1/\lambda = 3571$ intervals of 77 units, but these series of shorter intervals do not include as large a total number of bands as the series of longer intervals.

There appears, however, to be an entirely different scheme of classification, which is offered the reader as an alternative plan. It is found that several well-filled groups of bands can be arranged in pairs about a few centers. These centers take on more interest when it is found that they coincide with lines of the mercury spectrum. Occasional pairs from the Geissler tube spectrum of iodine can be arranged about the same centers, such lines being connected by dotted arcs in Spectrum No. 3. It is understood that Spectrum No. 3, like Spectrum No. 2, is a replica of Spectrum No. 1, which was plotted from the reciprocals of McLennan's values. The arcs in Spectrum No. 3 show how the bands can be grouped in concentric pairs.

In Table II. is given the frequency numbers of the mercury centers with the appertaining fluorescence bands, as well as the differences in frequency between bands and mercury center. Positive differences indicate that the bands are of smaller frequency and negative differences that the bands are of larger frequency than the frequency of the center. Although it is evident that the pairs are not always equally spaced about the centers the errors are no greater than those observed in the first method of classification. The mercury line or pair of lines which serves as a center is generally a fairly prominent line in a group of mercury lines, an exception being the first center, $1/\lambda = 2287$, or $\lambda = 4372$, which is a dim satellite of $\lambda = 4359$.

It is of interest to observe, in comparing the two plans of classification, that the second is not so universal in its application as the first, while the use of mercury centers suggests something akin to resonance, which is contrary to Professor McLennan's observations.

H. L. HOWES

PHYSICAL LABORATORY OF CORNELL UNIVERSITY,
October 30, 1917

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION G—BOTANY

THE only meeting of Section G for reading of papers took place at 2 P.M., Saturday, December 29, 1917, at the school of applied science, Carnegie Institute as a joint session with the Botanical Society of America and the American Phytopathological Society. The program consisted of the Vice-Presidential address followed by a Symposium on War Problems in Botany as outlined in the printed program. Dr. Bailey was prevented by war work from presenting his paper on the National Research Council. Dr. Coulter was not present, but his paper was read by Dr. H. C. Cowles. Dr. Smith was not present and his paper was not presented.

At the business meeting following the reading of papers, D. T. MacDougal was elected member of council, R. A. Harper member of Sectional Committee for 5 years and A. B. Stout member of general committee.

It was moved and carried that a committee be appointed by the chair to report to a later business meeting of the section on two considerations: (*a*) The organization of American botanists to forward the project of a pathological survey as suggested in the invitation paper of Dr. G. R. Lyman; (*b*) the possibility of assignment of drafted men of technical training and ability to scientific work of national importance and a recognition in some way that they are engaged in war service. The committee appointed by the chair consisted of G. R. Lyman. L. H. MacDaniels and C. L. Shear.

It was moved and carried that the business meeting adjourn till 9 A.M. Monday, December 31.

At the meeting of the Sectional Committee, December 29, the following members were present: Gager, Livingston, Blakeslee, Selby, MacDougal. Newcomb. Bartlett. Cook, Shear. A. F. Blakeslee was nominated for vice-president of the section for the ensuing year and Mel T. Cook for secretary for five years.

At the request of a group of botanical

editors the president and secretary of the section met with representatives from other botanical organizations to make plans for the publication of a journal of botanical abstracts.

At the business meeting 9 A.M., Monday, December 31, the committee on war activities of botanists reported resolutions which were adopted. These have already been placed in the hands of the permanent secretary.

A request was received from the organization committee of *Botanical Abstracts* for the election of two representatives from Section G on the board of control of *Botanical Abstracts*. B. T. Livingston was elected representative for four years and A. F. Blakeslee representative for two years.

A. F. Blakeslee,
Secretary

AMERICAN MATHEMATICAL SOCIETY

The twenty-fourth annual meeting of the society was held at Columbia University on Thursday and Friday, December 27–28, 1917, extending through two sessions on Thursday and a morning session on Friday. The attendance included forty-six members. Professors R. G. D. Richardson, of Brown University, and J. W. Young, of Dartmouth College, presided. The council reported the election to membership in the society of Dr. J. W. Campbell, Wesley College, Winnipeg; Dr. Mary F. Curtis, Western Reserve University; Mr. C. H. Parsons, Columbia University; Mr. J. B. Rosenbach, University of New Mexico; Mr. H. M. Terrill, Columbia University. Five applications for membership were received.

Committees were appointed to arrange for the summer meeting of the society at Dartmouth College in 1918 and for the summer meeting and colloquium at the University of Chicago in 1919.

The total membership of the society is now 735, including 77 life members. The total attendance at all meetings, including sectional meetings, during the past year was 338. The number of members attending at least one meeting during the year was 198. At the annual meeting 116 votes were cast for officers. The Treasurer's report shows a balance of $9,762.98, including the life membership fund of $6,333.13. Sales of the society's publications during the year amounted to $1,474.19. The Library now contains 5,475 volumes, excluding unbound dissertations.

At the annual election, which closed on Friday morning, the following officers and other members of the council were chosen: Vice-presidents, J. L. Coolidge and D. R. Curtiss. Secretary, F. N. Cole. Treasurer, J. H. Tanner. Librarian, D. E. Smith. Committee of publication, F. N. Cole, Virgil Snyder, J. W. Young. Members of the council to serve until December, 1920, R. C. Archibald, Dunham Jackson, D. N. Lehmer, J. B. Shaw.

The following papers were read at this meeting:

F. L. Hitchcock: "The coincident points of two algebraic transformations."

W. B. Carver: "The conditions for the failure of the Clifford chain."

C. J. Keyser: "The rôle of the concept of infinity in the work of Lucretius."

C. J. Keyser: "Concerning the number of possible interpretations of any system of postulates."

W. H. Wilson: "Systems of functional equations which define hyperbolic sine, hyperbolic cosine, sine and cosine uniquely."

C. H. Forsyth: "Tangential interpolation of ordinates among areas."

W. B. Fite: "Concerning the zeros of the solutions of certain differential equations."

R. L. Moore: "Concerning a set of postulates for plane analysis situs."

C. A. Fischer: "Integral equations involving Stieltjes integrals."

O. E. Glenn: "Preliminary report on a new treatment of theorems of finiteness."

C. L. E. Moore: "Rotations in hyperspace."

G. M. Green: "Memoir on the general theory of surfaces and rectilinear congruences."

J. F. Ritt: "On the iteration of rational functions."

Olive C. Hazlett: "On rational integral invariants and covariants of the general linear algebra."

Anna J. Pell: "Systems of linear equations."

Norbert Wiener: "Internal isomorphisms of complex algebra."

T. R. Hollcroft: "A classification of general (2, 3) point correspondences between two planes."

W. F. Osgood: "Singular points of analytic transformations."

M. T. Hu: "Linear integro-differential equations with a boundary condition."

Frank Morley: "Some general projective invariants of the algebraic plane curve."

Abstracts of the papers will appear in the March number of the *Bulletin* of the society.

The Chicago Section of the society met at the University of Chicago on December 28–29. The next regular meeting of the society will be held at Columbia University on February 23.

F. N. Cole,
Secretary

SCIENCE

FRIDAY, FEBRUARY 1, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE NEAR FUTURE OF BOTANY IN AMERICA[1]

THE honor of the vice-presidency and chairmanship of Section G came to the speaker following the removal, by death, in 1916, of Professor T. J. Burrill, who was originally elected to preside at the New York meeting last year. We may fittingly pause for a moment to recall to memory the one who, had he been spared, would have addressed us on this occasion. Older than the present speaker by nearly thirty-five years, he would have spoken out of a rich experience to the profit of us all. He was, as you well know, a pioneer in the science of phytopathology, the discoverer of the first recorded bacterial disease of plants, a successful teacher and scientific administrator, and a man whose nobility of character and genial disposition endeared him to all who knew him.

The title of this address was chosen and the body of it completed before it had occurred to me to consult the Proceedings of the fifty-first meeting of the association to see what might have been the subject of the vice-presidential address at the preceding Pittsburgh meeting, in June–July, 1902. It is therefore doubly interesting to note that Dr. Galloway's subject was "Applied Botany, Retrospective and Prospective."

The pendulum of the Section has thus completed what my professor of physics used to call one complete swing-swang,

[1] Address of the vice-president and chairman of Section G, Botany, of the American Association for the Advancement of Science, Pittsburgh, December 29, 1917.

both geographically and mentally. I make my own Dr. Galloway's statement that he chose his subject, "for the reason that it seems desirable at this time to emphasize some of the things that appeal to us as possibly having a marked influence on the future development of botanical work;" and also his further statement, even more true to-day than sixteen years ago, that it is one of the most hopeful signs of recent changes in botanical science "that our progress has constantly been in the direction of a stronger place in the world's usefulness and a higher plane of scientific thought."

A writer in a recent magazine has said:

> That the war is going to make great changes in the political, economic and social conditions of the world, in ethical values and in moral standards, any fool can see.

The members of Section G, as indeed the entire membership of the American Association for the Advancement of Science, may well inquire, and are inquiring at this time, what the effect of the world war is going to be on science. To scientific men it is self-evident that the methods of modern science will be in no wise affected by the war. To the end of time, as we firmly believe, truth must be ascertained by the well-tested method of observation, inference and deductive verification.

And the content of science—the great body of truth? There was a time when it might have been fundamentally altered by political or religious upheavals. It is comparatively modern history that the fact of the earth's axial rotation stood or fell as orthodox doctrine with religious and political changes. We believe that day is forever past, and that the content of science, now and hereafter, will always be determined by the unbiased test of observations and hypotheses. But in certain definite ways science can not help but be profoundly affected by the present world conflict.

In the first place, the war must eventually make it more evident than ever to the thinking portion of our citizens (including even legislators, if we may indulge in a little Christmas optimism), that science is a necessity for any modern state. They were the fanatics of the French Revolution that declared, as they severed from its body the head that introduced exactitude into chemical research, "The republic has no need of savants."

In the face of the Hun's bombastic and naïve iteration of Teutonic superiority in all departments of human endeavor, it is specially interesting to note that, since the execution of Lavoisier, no state has officially committed the fallacy of such a doctrine except Austria! Said Francis I., of Austria, to a group of professors in 1815:

> *I have no need of learned men,* I want faithful subjects. Be such; that is your duty. He who would serve me must do what I command. He who can not do this, or who comes full of new ideas, may go his way. If he does not I shall send him.[2]

Germany has never formally disavowed her use of scientific men, but the Right Hon. J. M. Robertson, in a recent pamphlet, recalls Heine's opinion that all German philosophers and their ideas would have been suppressed by wheel and gallows but for the intervention of Napoleon in 1805.[3]

The present war has made it universally recognized that science and scientific

[2] Hazen, "Europe since 1815," p. 19.

[3] An echo of this condition is the old student song, current in the University of Berlin as late as 1877:

The original German version localizes the place where freedom of thought and speech were held in such restraint:

"Wer die Wahrheit kennet und sagt sie frei,
Der kommt *in Berlin* auf die Stadt-Vogtei."
"Who knows the truth and freely speaks
On him the law its vengeance wreaks."

method are prime essentials for the welfare of a state. Germany has taught the world other lessons besides the futility of international infidelity, the ineffectiveness of barbarism in a world of civilization, the weakness of terrorism and low insult when confronted by patriotism and by individual and national self-respect. She (though not she alone) has taught the civic value of science.

The failure of England to recognize the civic value of science has been publicly noted in recent debates in the House of Lords. A notable case in point, of special interest to botanists, is the passing of a resolution (now happily repealed) to suspend the publication of the *Kew Bulletin*. Remarking on this, *Nature* (in a recent number) declared that,

> unless we learn in time the lessons which this war is enforcing on every side, namely, that the way of prosperity in the future lies in promoting scientific knowledge *and utilizing the results of scientific investigation* (italics mine), it will make but little difference in the long run whether we win the war or not.

And again:

> . . . the same official lack of appreciation of the importance of scientific inquiry and research, which was a matter of common knowledge amongst our competitors before the war, still continues to sap the foundations of our recognized claims to our foreign possessions, which should largely rest on the encouragement of their material development on sound economic, and therefore on scientific lines.[4]

Science for science's sake, like art for art's sake, may be a noble sentiment, but its limitations should not be lost sight of. Society is justified in asking of every scientist, as of every other man, of what use can you be in the body politic? But though there is no place for the useless, usefulness may not always be at once apparent. "It is perfectly natural," said John Tyndal,[5] "for persons who have little taste for scientific inquiry and less knowledge of the methods of Nature, to feel amused, if not scandalized, by the apparently insignificant subjects which sometimes occupy the scientific mind. They are not aware that in science the most stupendous phenomena often find their suggestion and interpretation in the most minute—that the smallest laboratory fact is connected by indissoluble ties with the grandest operations of Nature." Huxley, also, long since pointed out that as Saul found a kingdom while seeking his father's asses, so many great discoveries have resulted from the pursuit of illusions which seemed asinine to the uninitiated.

Thus, one hundred years ago nothing could probably have seemed more remote from the practical affairs of everyday life than the use of pollen and the relation between insects and flowers, yet a few decades sufficed to show that that knowledge is fundamental to the experimental investigation of heredity and the prosecution of practical plant breeding. While one can not, and indeed should not, always go deliberately after the immediately applicable, there is no reason why scientific men should be loath to do so, nor be in danger of scientific ostracism when they do. Those who may be inclined to take issue with this point of view need only recall the illustrious names of Sir Humphry Davy, of Lord Kelvin, of Count Rumford, and, in botany, of Thomas Andrew Knight, Louis Pasteur, Marshal Ward and others. Botanists, of all men, recalling their dependence upon microscopes and microtomes, thermometers and evaporimeters, balances and thermostats, and especially on aniline dyes, should be the last to belittle the value and dignity of applied science.

It is a pleasure to note what is, no doubt,

4 SCIENCE, June 22, 1917, pp. 630–631.

5 "New Fragments," p. 143.

in some of your minds already, that the history of botany during the past two decades is of such a character that the above paragraph comes perilously near having the appearance of setting up a straw man in order to knock him down. Fortunate for botany that this is so, for there has never been a time in the world's history when every individual, every nation, organizations of every kind, every science and every other intellectual discipline have been under such compelling necessity of demonstrating their usefulness. Germany, by unchaining a world war, has unintentionally conferred one of the greatest of blessings on mankind; she has compelled us to think greater thoughts, to seek higher ideals, to achieve greater things than ever before. By the most savage assault ever made on civilization, wrecking universities, bombarding churches and school houses, burning libraries, destroying orchards and forests, ruining laboratories and scientific apparatus,[6] she has compelled every nation, every department of knowledge to become as useful as possible.

Recognizing how almost impossible it is for thinking men, living in the most momentous period of the world's history, to hold their minds for long at a time on any subject not more or less directly connected with the great world events now taking place, it has seemed to the speaker that the only topic suitable for consideration on this occasion is the utility of botanical science, with special reference to suggestions for a botanical program in the near future in America. What modifications, if any, are necessary, in the present program of organized botany, in order to make it more preeminently a useful science?

Chemistry, physics, mathematics, meteorology, are all directly useful in the conflicts of war, enabling men to manufacture high explosives, and to fire them with speed and accuracy under most unfavorable conditions of weather. But it has recently been the proud boast of medicine that she has been useful in wartime only in preventing sickness or alleviating suffering. Botany may also enjoy whatever comfort is to be derived from this proud boast. It is indeed true that one of the poisonous gases used by the Germans in the present war is produced from the seeds of the tropical plant, sabadilla (*Sabadilla officinalis* Brandt), and this suggests that botanical exploration, might (with the cooperation of chemistry in the bloody work!) render services of direct value in active fighting. But, with almost negligible exceptions, the services which botany can render the state are those needed in times of peace as well as war, are directly constructive rather than destructive, and contrary to a general impression, are indispensible and far-reaching.

It is now universally recognized that the most effective preparedness consists in keeping always prepared. The most effective safeguard against tuberculosis is to live *always* so as to insure a sound vigorous body, resistant to any attack of the disease. The surest and most efficient way to insure adequate food, fibers, timber, paper and other plant products necessary in time of war is to encourage and support *at all times* the study of plant physiology and ecology, plant breeding, plant pathology, scientific forestry and research in agronomy, horticulture and general agriculture.

The surest way to make botany useful is to follow out a program of research in pure science; for practical needs are almost always met by applying to some special case that which is at hand ready to be applied, and which was not ascertained with ulti-

6 Old and apparently favorite German practises. See, for example, M. Vallery Radot's "Life of Pasteur," Eng. tr., pp. 188–192.

mate uses in view. That there can be no applied science unless there is first something to apply, is a truism; it appears to be one of the most difficult ideas for the layman to understand, and yet we are almost entirely dependent upon laymen for the funds necessary for research in pure science.

I have tabulated, below, some of the various ways in which research and the fruits of research in botany may contribute to our national resources in peace, and thus to preparedness for war or for any other crisis.

1. RESEARCH IN PURE SCIENCE

(*a*) Genetical studies to ascertain the principles of heredity in man and animals as well as in plants.

(*b*) Plant physiology, increasing, among other things, our knowledge of the nutritional needs of crops, and affording a rational basis for fertilizing, crop-rotation and other crop problems.

(*c*) Plant ecology. The economic value of ecological studies was discussed by Professor Cowles in his vice-presidential address before Section G, in 1914. As he then pointed out, one could not foresee that a study of the succession of vegetation on the sand dunes of Lake Michigan, stimulated merely by interest in pure science, might afford the only basis for the just settlement of a lawsuit in Arkansas involving property rights to the extent of several millions of dollars. Yet such was the case, as many of my hearers recall.

Even more significant is the application which has been made of our knowledge of wild vegetation to determine what agricultural crops are best adapted to a given region.

Several years ago the speaker was asked to make a study of a certain locality to ascertain whether a widespread injury to vegetation was or was not caused by fumes from the stacks of near-by manufacturing plants. By careful measurements of the thickness of the layers of annual growth of tree trunks it was shown that an abrupt decrease in growth and vigor was contemporaneous with the establishment of the manufacturing plants. This, with other evidence, rendered a final decision easy and certain.

On the basis of Crocker and Knight's studies of the effect of illuminating gas on carnation flowers, together with other evidences, I have several times submitted a report that saved a gas company an expensive lawsuit, and also secured justice to the florist.

It might have been difficult 10–15 years ago to forsee what economic good, if any, could result in a careful mapping of the geographical distribution of *Sphagnum* moss, yet, according to Rendle, *Sphagnum* has come to be greatly needed for surgical dressings, and all information as to *Sphagnum* areas, their accessibility, size purity of growth, etc., has assumed large importance.

Very few persons would have imagined that a study of the fermentation of horsechestnut seeds would have in it any possibilities of practical application, but we learn that thousands of tons of these seeds are now required in Great Britain in the manufacture of munitions of war, and that every ton of seeds used means the saving of half a ton of grain. So instances might be multiplied.

(*d*) Plant pathology, including a study of the life histories of parasitic organisms, affording information essential for a rational diagnosis, prophylaxis, and treatment; the physiology, ecology, and geographic distribution of phytopathogenes.

To one who can appreciate the value of research only in terms of dollars and cents,

it may be pointed out that the comparatively new blister rust of white pines is threatening with destruction trees estimated to have a total value of about $400,000,000. Measures for combating this disease were discussed at the International Forestry Conference, at Washington, D. C., in January, 1917. It is common knowledge among botanists that the annual loss in this country from imported plant pests amounts to hundreds of millions of dollars. Would an expenditure of a million dollars a year be too much to promote botanical research that might reduce this loss by 50 per cent. or even by 25 per cent.

(*e*) Pharmaceutical experiment stations, for the promotion of investigations, of drug plants and poisonous plants. So far as the speaker knows, the Wisconsin Pharmaceutical Experiment Station, established four years ago, is the only state institution of the kind in the United States, though generous provision is made for pharmaceutical research by several commercial firms, including experimental gardens, laboratories, and investigators.

2. EDUCATION

(*a*) The publication of books and magazines of reliable popular, as well as technical information about plant life, and the history, scope, aims, methods, results, and value of botanical science. A general knowledge of "first aid" for poison-ivy and poison-sumach, and a knowledge of poisonous and edible mushrooms might, under easily imagined circumstances, be of inestimable value to an army in the field.

(*b*) Botanical exhibits in museums, showing the economic value of the fruits of botanical research. According to the *Official Bulletin* of the National Committee on Public Information (July 25, 1917), the Smithsonian Institution has announced that the Division of Mineral Technology, of the United States National Museum, in keeping with its policy of interpreting the technical aspects of the mineral industry to an ever-widening public, has prepared a graphic and striking set of exhibits designed to present in true perspective the significant features of the fertilizer situation.

Why do we not read of graphic and striking exhibits demonstrating to an ever-widening public the value to society of applied botany? Surely the materials for such an exhibit are abundant and of genuine popular interest.

(*c*) Promotion of the study of botany in high schools and colleges, involving

(*d*) A more serious consideration of such educational topics as the content of the high-school and college courses. Should the introductory course in the agricultural college differ from that in the college of liberal arts? What revision, if any, of the present high-school and college courses will probably be necessary or desirable after the war in order that botany may hold its own and keep properly adjusted to the changes that will surely come in education in general? It is not desirable that every botanist give attention to such problems, but they are important; their solution one way rather than another may make a great deal of difference in the number and caliber of the young men who decide to devote themselves to botany; and there is every reason why their solution should not be left entirely to pedagogues.

3. EXPLORATION

The director of a large museum once remarked to the speaker at a scientific meeting where an enthusiastic explorer, just returned, reported the discovery of ten species new to science, "What a pity!" Notwithstanding the large element of truth in that remark, the discovery of new spe-

cies may have real value. If one could only, for example, fill in the gaps between cycads and ferns, or between monocots and dicots! But such work as is now being carried on by the Office of Foreign Seed and Plant Introduction, of the U. S. Department of Agriculture, with the deliberate purpose of discovering useful plants hitherto unknown or little known, and establishing them in new countries will do more toward winning respect and support for our science from the general public than will the discovery of a new lichen or of a new moss, and is quite as likely to result in valuable scientific contributions. The world is indebted to Fortune, a botanical explorer and collector, for the introduction of the tea plant into farther India.

4. Sanitation

(*a*) The purification of potable water from deleterious vegetable life, including the microscopic examination of water; a problem fairly well solved at present.

(*b*) Afforestation of the watersheds of city reservoirs.

5. Agriculture and Horticulture

(*a*) Studies of soil-fertility, crop-rotation, ensilage, utilization of unproductive soils, plant diseases. Our friends the chemists have always claimed the credit for most of our knowledge of soil fertility, but most botanists have never been able to shake off the superstition that somehow or other the successful growing of crops is, in part at least, a botanical problem. It now turns out[7] that the transformation of rock phosphate, the oxidation of sulfur, and the oxidation of iron in soils, all essential to soil fertility, are probably accomplished by physiological processes of the soil flora, partly by the bacteria, but to a larger degree by several species of molds. Whether the formation of available potassium is also dependent on the action of molds remains to be determined, and a whole series of problems here opens up, equally important to pure and to applied science.

(*b*) Plant breeding, the application of the fundamental principles of genetics to the production of varieties of larger yield, better quality, resistant to disease and drought, adapted to soils hitherto of little agricultural value (as blueberry culture on the pine barrens of New Jersey and elsewhere), or adapted to various climatic conditions.

For example, recent experiments of Pritchard[8] indicate that differences in the size and sugar content of individual beet roots show no evidence of inheritance. They are fluctuations, and play no part in the improvement of sugar beets. Pritchard concludes that the cost of analyzing mother beets is an absolute waste of money. But a certain European firm is accustomed to carry out several hundred thousand analyses annually in the selection of roots for seed production.[9] These analyses entail a very large annual expenditure. It therefore becomes a problem of considerable economic as well as scientific importance. Many other similar problems could be readily mentioned.

6. Food, Fiber, and Drug Supply

(*a*) The cultivation of drug plants as crops, and the endeavor to secure varieties superior in yield or quality.

(*b*) Study of the absolute and relative food value of various plants, especially of those little known or little used for food; the utilization for food, drink, and fibers

[7] Brown, P. E., "The Importance of Mold Action in Soils," Science, N. S., No. 46, 171–175, August 24, 1917.

[8] *Jour. Amer. Soc. Agron.*, 8: 65–81, 1916.

[9] Harris, *Am. Nat.*, August, 1917.

of plants not hitherto considered of value for such purposes.

For example, a shortage of tea in Hungary has resulted in an investigation of the leaves of various species of brambles (*Rubus*). Nearly 2,000 cwt. of leaves was collected by school children from 12,000 localities. Some of the results are reported as favorable.[10]

The Brooklyn Botanic Garden has recently been asked by a large paint company to recommend a plant that will yield a fiber that may be substituted for rags in making felt paper for roofing, and other similar purposes. This fiber is needed at once at the rate of about 10,000 tons a year. The company has been trying *Zostera*, but not with entire success.

Inquiry has also been received for a substitute for jute that can be grown in this country successfully in commercial quantity.

A most valuable program of work along these lines has recently been published by The Botanical Raw Products Committee of the National Research Council. Why should such investigations be left largely to chemists, physicians, and others, as has commonly been done heretofore?

7. Forestry

(a) Much has already been accomplished, by the excellent work of our forest schools, toward the development of scientific forestry. The successful cultivation of trees in city parks and streets is still a baffling problem. The reforestation of devastated areas in northern France and Belgium will demand the fullest possible knowledge of the principles and practise of arboriculture and forestry. Preparation for such emergencies can be made only in time of peace and can not be accomplished in a hurry.

[10] *Internat. Rev. of Sci. and Prac. Agr.*, 8: 47–48, January, 1917.

8. Conservation

(*a*) So much has been published and spoken on this topic within recent years, that it needs only to be mentioned here. There are still many important unsolved problems relative to the conservation of forests and of garden crops by canning and drying; the utilization of forest products, and substitutes for them (*e. g.*, substitutes for wood pulp in paper making) and the conservation of soil fertility.

To one who has never given much thought to this subject the above may seem like an ambitious program. To the members of Section G, of course, it does not. Much of it, fortunately, is already under way; many items have been omitted. The *First Report* of the Committee on Botany of the National Research Council tabulates several other problems already undertaken. What is needed is to prosecute these problems with more system and vigor, to secure more ample funds for carrying on the work, and to insure that every botanist assumes the proper attitude of intelligent sympathy toward the whole program. May I not briefly call attention to three or four of the problems which seem to be more pressing than some of the others, and the solution of which should be included in the botanical program of the near future.

1. *Increased Facilities for Publication.*—This audience does not need to be reminded of the pressing need of additional opportunity for publishing the results of investigation. Botanical research was never produced in this country of better quality and in such large quantity. It is surprising how easy it now is to secure a program of research papers in botany. Between April and October, 1917, there have been held two meetings of botanists in New York City alone at which a total of fifty-two papers were offered embodying the unpublished results of research. This is exclu-

sive of papers read at numerous meetings of local societies. In the meantime many more additional papers have appeared in print. According to a computation by G. F. Scott Elliot, there were printed in 1905 more than a quarter of a million pages of botanical contributions, in eight or nine different languages. By 1914 this number must have been increased to at least 300,000 pages, though there has been a falling off in England and Europe since the outbreak of the war. But only a portion of the annual output of manuscript is provided for. Most of our botanical periodicals now have in hand copy enough to more than fill their next volume, and some are eighteen months ahead.

How are the necessary additional facilities to be secured? The most economical way, for both publisher and subscriber, would be to enlarge existing magazines, increasing the number of pages, and the frequency of issue, and where necessary, making two volumes a year. The overhead charges for publishing would thus not be greatly, if any, increased, and there would be an immense gain in restricting the number of separate journals to be cited, to be kept track of, and subscribed for.

The problem is also closely bound up with that of botanical organization, to be briefly spoken of in a moment. Three separate societies, each with a membership of five or six hundred, and annual dues of from five or six dollars, might, with successful advertising and a subsidy, each issue a specialized magazine of modest proportions. But where are the subscribers to be found? Chiefly among botanists, of course; but the minimum number necessary for each journal would mean a total membership of from 1,500 to 1,800. To secure this would necessitate considerable overlapping of membership. For one person to support all three would entail dues of from \$15 to \$18, in addition to subscribing to any abstract journal that might be established. With other professional demands, such a tax would be burdensome or prohibitive to many, if not the majority, and would entail the great disadvantage of depriving them of ready access (which one's personal copy gives) to literature not directly bearing on their special interest, though more or less related to it. Nothing could be more unfortunate, though an abstract journal or a journal along the lines of *Science Progress*, would tend to counteract this.

Before further steps are taken toward the establishment of additional periodicals, careful consideration should be given to the question of how existing journals may be enlarged or modified to meet the present needs, and what kind of additional journal, if any, is needed. It is not improbable that an annual payment of not more than ten dollars might suffice to meet membership dues in an enlarged Botanical Society of America, and at the same time enable the member to receive two and possibly three periodicals. The chemists have already accomplished this. I do not mean these words to have an air of finality, but merely to present phases of the problem that should be given most thoughtful consideration.

2. *Abstract Journal*.—The very bulk of publication has now rendered a journal of botanical abstracts a most urgent necessity. No one, if he desired, could possibly find time to read all the articles published in full; not even those more directly in line with his own special interest. To keep reasonably intelligent as to what is going on in botany outside of one's own specialty is almost impossible. The "Notes for Students" in the *Botanical Gazette*, and the abstracts in the *Experiment Station Rec-*

ord and other journals have been a boon to all of us, but are now proving inadequate. The opportunity is ripe for the establishment of a journal of botanical abstracts in America; such an opportunity may never again recur; it should not be allowed to pass.

3. *A Popular Journal.*—Our science would greatly profit from the publication of a journal, of the high character of, for example, the *National Geographic Magazine,* seeking to interpret to the general public in an interesting and authoritative manner the methods and results of botanical science. There is ample material for such a publication, and it would be heartily welcomed by the great body of high-school teachers of botany, as well as by many amateurs and nature lovers.

4. *Botanic Gardens.*—The speaker will certainly be excused from urging the value and need of botanic gardens. Ways in which they not only further the cause of botanical science, but may serve an entire community, as well as its public-school system, are so numerous, as has already been demonstrated, that the members of the Section and of the Botanical Society of America might well become interested in an organized effort to secure the establishment of botanic gardens of reasonable size and scope, but of scientific and educational worth, in every American city of 10,000 or more inhabitants.

5. *Need of More Popularizing.*—The Latin nomenclature in botany is about all that is left to remind us of a period, not so very far distant, when the fruits of scientific research were kept inaccessible to all but the learned few by being published in a foreign, and even in a "dead" language. At that period, owing to lack of educational opportunities for the masses, the general public could hardly have understood or appreciated the subject-matter of science even if published in the vernacular. Happily the situation is different now, for although the scientists have difficulty in understanding each other, the general public shows an intelligent and eager appreciation of the results of modern science, if only it is presented in non-technical language. The difficulty is to get popular articles and books from those most competent to prepare them. Faraday and Lodge in physics, Tyndall and Duncan in chemistry, Herschell and Ball in astronomy, Geikie and Winchell in geology, Huxley and Agassiz in zoology, Errera and Gray in botany did not hesitate to give time to the writing of popular articles and books; and I never heard any one suggest that their research or their reputations as leaders in scientific thought suffered in the least thereby. For several years, however, there has been a general disposition in botany to follow the lead of an erstwhile famous trust magnate, and let "the public be damned," leaving popular interpretation to reporters and professional popularizers. As a natural result, popularizing and substantial scientific work came to be regarded in certain quarters as mutually exclusive, and the reputation of our science, outside of its own charmed circle, suffered much. A botanist holding a purely research position, but having undoubted ability at popularizing, recently expressed to me his hesitancy at writing anything popular for fear his reputation would suffer among his botanical contemporaries.

But on what do I base my plea for more popularizing? First, on the altruistic basis that we owe it to the public. To contribute toward raising the general level of intelligence is a duty as well as a privilege, especially in a democracy; to those having

the gift it ought to be a genuine pleasure and satisfaction.

Second, on a purely selfish basis. Like practically all other sciences, botany has now reached a stage where further advance is largely dependent upon laboratories and a more or less elaborate and expensive equipment, including library facilities, costly apparatus and laboratory assistants. The time has passed when board and room and traveling expenses are enough. 'Tis money makes the mare go, in botany as elsewhere, but until the millenium has less the appearance of being viewed through the little end of the telescope, botanists will be dependent upon outside sources for adequate financial support. But such sources will fail, or continue wholly inadequate, as now, so long as the dwellers outside the walls have no lively appreciation of the fact that money needs science just as truly as science needs money.

Only a few months ago an attempt was made by the speaker to enlist the interest of certain seedsmen and nurserymen in furthering research in plant diseases. Letters were sent to various firms and individuals whose interest in such a proposition was mainly taken for granted. These letters contained the following statement:

The importance of increasing our knowledge of the causes and prevention of plant diseases is evident to every one who is interested in growing plants on a large scale. An enormous amount of investigation is now in progress in this country, along this line, but it is obvious that an opportunity for the prompt publication of the results of these investigations is essential to progress. Opportunities for such publication are, at present, very limited, and practically without any financial backing, except for the publications of the federal and state government. The latter publications are open only to officials, and are far from equal to the demand. Will your firm not be willing to give this matter serious consideration, and grant a personal interview between the undersigned and some member of your firm?

The following reply was received:

Dear Sir: Your favor of the 29th inst. duly received. In reply thereto would say that, while we realize the importance of the work you are interested in, yet we feel, from a business standpoint, that the burden of such work should not fall upon us or similar houses. We take every precaution (*sic*) to keep stock healthy and true to type. We are satisfied that a great deal of the disease is due to improper cultivation, and when proper conditions of growth are supplied, disease is very rarely to be met with. Of course, unfavorable seasons will occur; conditions will arise which are absolutely beyond the control of the cultivator; but *we are satisfied that no amount of investigation as to the causes of disease affecting field crops can ever result in avoiding it.* (Italics mine.) We feel it will be unnecessary for you to come in to talk to us on the subject, as we are satisfied that nothing could be achieved thereby!

Hope springs eternal in the human breast, and so I attacked the enemy's salient with a little asphyxiating gas, as follows:

Such a view (as yours) is diametrically opposed to the results of the investigations on plant diseases carried on in nearly every civilized country during the past twenty-five to thirty years. Of course proper cultivation is always essential to the health and success of our crops, but these researches have yielded an abundance of positive evidence that most plant diseases, like many human diseases, are contagious, being caused by bacterial and fungous parasites, or by insects, and are, in very many cases, subject to control, or at least to remedial treatment, which is a matter quite apart from proper or improper cultivation.

May I not cite such well-known cases as the wheat rust, which caused a loss of $67,000,000 in the United States in 1891; the oat smut, which caused a loss of over $13,000,000 in the state of Wisconsin alone in 1901–13; the late blight of potatoes, which caused a loss of $10,000,000 in the state of New York in the one year of 1904, the black rot of cabbage (loss $50,000 in Wisconsin in 1896); and the leaf spot of violets (loss $200,000 in the United States in 1900).

Each of the above diseases is perfectly well known to be caused by a parasitic fungus, and remedial measures, which a knowledge of the nature and cause of the disease has made it possible

to prescribe, have resulted in very greatly diminishing these enormous financial losses.

I might also mention wilt-resistant cotton and cow-peas, wilt-resistant tobacco and flax, rust-resistant asparagus and durum wheat, grape vines resistant to *Phylloxera*, cantaloupe resistant to leaf-spot disease, and many others, all showing that the matter of plant diseases is quite apart from the methods of cultivation.

Since many diseases are known to be transmitted from crop to crop by being carried by seeds, it would seem as though such information would be considered as of fundamental importance to all seedsmen and nurserymen, and that is why it was a matter of such genuine surprise to me that such houses do not feel any interest to cooperate in the advancement of our knowledge by rendering even moderate financial assistance.

I then expressed my firm conviction that every large seedsman could materially increase his business and his profits by the appointment of a plant pathologist, and a plant breeder, and that the appointment of a pathologist by seedsmen and nurserymen would, some day, be as much a matter of course as the appointment of a chemist now is for a dye-works.

The courteous reply to this read, in part, as follows:

Your very interesting letter was duly received, and we have carefully noted contents. . . . We desire to say that we think it is not the province of the individual to take up the burden of such effort as is mentioned in your letter.

The moral of this is, ladies and gentlemen, that you can lead a horse to water, but you can not make him drink. You can never get a man to put his money into anything he doesn't understand or that doesn't interest him, no matter how important or worthy the cause may be; and in this incident I find one of the most cogent arguments why scientific men should make it a part of their main business to interest and enlighten the general public concerning the nature and value of scientific work. How can we expect men to endow scholarships and fellowships for botanical research when their conception of the science, if they have any at all, may be adequately stated by the expression, "How to know the wild flowers"? Botanic gardens and the popular magazine referred to a moment ago, will contribute to the end desired, but we need more books, and lectures, and magazine articles of literary as well as scientific value, written for the people by the leaders in botanical science.

6. *Botanical Organization.*—Closely connected with the problem of securing an enlightened and interested constituency is the character of scientific associations. On first thought it might appear desirable that scientific specialization should be reflected in the organization of small groups of workers on the basis of their special interests. But here, again, there is danger that one of the most important advantages of organization may be lost sight of. I refer to the opportunity of making science recognized outside of scientific circles as a force and a necessity in the larger affairs of life. It is a mistake to imagine that our botanical clubs and societies are solely for individual convenience and advantage; they also exist, or should exist, for the larger purpose just stated. There frequently arise occasions when science, as such, needs to make itself felt, to assert itself by taking group action. Organized effort is often necessary to secure desirable legislation or to thwart undesirable or vicious legislation. A memorial to the Congress urging an appropriation for botanical exploration in South America, backed by an association of 50 or 100 members of a botanical society would, in all probability, have little effect in securing the desired legislation, but something might be accomplished by several thousand botanists in one large vigorous association. It requires eternal vigilance now to combat the pernicious anti-

vivisection propagandum; how hopeless it would be with science unorganized, or organized only in small scattered groups. In matters touching the place of botany in education, the content of the course of study, the conservation and scientific utilization of plant resources by the nation, appropriations for research, provision for publication, as mentioned above, the influencing of public opinion in many ways, and on numerous other occasions requiring effective group action, the advantage of one strong, dignified, aggressive organization, known and respected by the general public should be at once recognized.

It is from such considerations as these that I believe it is highly desirable that there should be such an organization as the American Association for the Advancement of Science, and especially that botanists should contribute as much strength as possible to the association by supporting a botanical section. It is an immense advantage, and might conceivably become a matter of critical moment, to have a strong national federation of all the scientific activities of the nation.

It is for similar reasons that I believe a segregation of botanists into several relatively small organizations, in certain ways, would be disastrous to the best interests of botanical science. "In union there is strength" is as true for science as for politics. The ideal condition would seem to be one large organization, representing botanical science as a whole, but comprising as many sections as size and coherence of various special interests may justify. It would be a real misfortune to undo the good accomplished in 1906 by the federation of several smaller organizations into the Botanical Society of America. The Botanical Society of America needs every botanist as truly as does every botanist need the society.

7. *Botanical Education.*—There are weighty reasons why the study of botany should form a part of the schooling of every one seeking a liberal education, unless we are prepared to abandon the age-old principle that intellectual culture, *per se,* has intrinsic value as well as does vocational proficiency. A general course, without laboratory work, consisting largely of illustrated lectures and assigned readings, touching on the history of the science, its philosophical aspects, its relations to knowledge as a whole, and to problems of everyday life, should be more generally introduced into our colleges. Such a course would not only result in a more widespread intelligence about plants and the science of plants, but would be certain to increase the number of those electing botany as a life work. It would be valuable for those intending to practise law, medicine, theology or journalism. If democracy is to survive, says a recent writer, not only must culture be shot through with practical efficiency, but practical efficiency with culture. The first course in botany should always be planned on the supposition that it is not only the first course, but may also be the last.

Contrary to a prevalent notion, statistics show that botany as a high-school subject has rapidly lost ground during the past few years. This is due largely to the absence of any organized effort to adapt the science in accordance with the present-day tendency to place every subject on an industrial basis. The Report of the Commissioner of Education for 1916 shows that, between 1910 and 1915, the enrollment in botany in the high schools of the United States decreased 44 per cent., only 7.9 per cent. of the total high-school enrollment taking botany. The enrollment in agriculture has increased from 4.55 per cent. to 6.92 per cent., and in domestic science from

4.14 per cent. to 12.69 per cent. As Downing[11] has pointed out, these and other similar figures indicate that

> Botany and zoology are apparently giving way to related subjects that either appeal to school authorities as more effective educationally or to the public as more closely allied to every-day affairs. . . . The data for botany and zoology are indicative that another decade will see these biological subjects eliminated from the high-school curriculum.

From similar data compiled for the state of Missouri, a committee of the Missouri Society of Teachers of Mathematics and Science conclude that

> There is no longer any demand for science for science's sake in the curriculum of the secondary school.

The situation is a challenge to all who are or who should be interested in the place and function of botany in the schools.

The solution of the problem lies not in reducing botanical instruction to a purely vocational basis, but in joining with all scientific and educational forces to combat the vicious tendency to commercialize all popular education. President Butler has declared that "the growing tendency of colleges and universities to vocationalize all their instruction," is "closely related to poor teaching." It is also closely related to distorted ideas of relative values, and to poor scholarship, and threatens insidiously to undermine the very foundations of applied science. As Professor Keyser[12] has effectively stated:

> It is said that intelligence is good because it prospers us in our trades, industries and professions: it ought to be said that these things are good because and in so far as they prosper intelligence.

In conclusion, a brief word concerning the aims and content of advanced botanical education for those intending to enter botany as a profession. Here two clearly distinct problems stand out: the teaching of botany and the education of botanists. The two are not synonymous. One needs to have something more than a knowledge of law to make a successful lawyer, something more than a knowledge of disease and *materia medica* to make a successful physician, something more than a knowledge of plants to measure up to what should be the highest ideals of a botanist. Knowing all the botanical facts, one should also be able to see his science in long perspective, to understand the painful and halting steps by which a science of botany gradually emerged from the cultivation of vegetables and simples, its relation to other sciences, to the intellectual and economic life of mankind, and to the broad philosophical problems, the solution of which is the final goal, the deepest satisfaction and the largest justification of all intellectual endeavor. One should not only be intelligent in his subject; he should also be intelligent about his subject. If we see no further ahead than chromosomes and genes, species and sieve tubes, mutants and enzymes, important as these are, we are of all men most miserable. The outstanding names in the history of botany, as in every other science, are of those who have had a broad philosophical grasp of their subject.

In botanical education, also, we should never lose sight of the fact that the man is more important than the science. There is not time to go into details; what I have in mind is said better than I can say it in a short note by Curtis in SCIENCE for August 24, 1917 (pp. 182–183). The idea is succinctly stated in the last sentence, which I here paraphrase: To teach botany is one thing; to teach men to be botanists is a greater task.

I once heard the late Hamilton Wright

[11] Downing, Elliot R., "Enrollment in Science in the High Schools," SCIENCE, N. S. Vol. 46, 351–352, October 12, 1917.

[12] SCIENCE, N. S., Vol. 41, 447, March 26, 1915.

Mabie, referring to German scientists, quote some one as having said: In no nation have the scientific men dived deeper in the sea of knowledge, nor staid down longer, nor come up muddier. By all means let us dive deep, and explore widely; but for the sake of ourselves, as well as of our science, let us see to it that our advanced and graduate courses do not produce men who come up muddy. C. STUART GAGER

SCIENTIFIC EVENTS

MINING IN ALASKA IN 1917

THE annual report on the mineral resources and mineral production of Alaska in 1917 is now in preparation under the direction of G. C. Martin, of the Geological Survey, Department of the Interior. Some of the important features of this report relating to mining development during the year are abstracted in the following statement. Complete statistics of the mineral production of Alaska can not be collected within less than three or four months after the close of the year, but meanwhile it is desirable to publish the preliminary estimates here given, which are believed to vary not over 5 per cent. from the actual figures.

The value of the mineral production of Alaska in 1917 is estimated at $41,760,000, exceeding that of any previous year except 1916, which was $48,632,000. The decrease in 1917 was therefore about $6,870,000. During 33 years of mining Alaska has produced over $391,000,000 worth of gold, silver, copper, and other minerals.

Alaska mines are believed to have produced gold to the value of about $15,450,000 in 1917, compared with $17,240,000 in 1916. The total value of the gold mined in the Territory is now about $293,500,000, of which $207,000,000 has been won from placers. In 1917 about 88,200,000 pounds of copper was produced in Alaska, valued at about $24,000,000. The production in 1916 was 119,600,000 pounds, valued at $29,480,000. The total copper produced to date is 427,700,000 pounds, valued at $88,400,000.

The value of Alaska's lesser mineral products in 1917 was about as follows: Silver, $1,050,000; coal, $300,000; tin, $160,000; lead, $160,000; antimony, $40,000; tungsten, chromium, petroleum, marble, gypsum, graphite, platinum, etc. $600,000. The year 1917 marks the first production of chromium in Alaska, and about 81 ounces of platinum was saved in placer gold mining at several widely separated localities.

The data in hand indicate that the value of the placer gold output in 1917 was $9,850,000; in 1916 it was $11,140,000. The decrease was due chiefly to restriction of operations because of the high cost of supplies and the scarcity of labor. The placer output was increased only in the Tolovana, Marshall, and Ruby districts and at the new Tolstoi camp.

About 33 gold-lode mines were operated in 1917, compared with 29 in 1916. The value of this lode-gold mined decreased from $5,912,000 in 1916 to about $5,250,000 in 1917. The decrease was due chiefly to the disaster at the Treadwell mine. Southeastern Alaska, especially in the Juneau district, is still the only center of large quartz-mining development in the territory. Next in importance is the Willow Creek lode district. Gold-lode mining on Prince William Sound, Kenai Peninsula, and in the Fairbanks district is at a standstill.

The copper production of Alaska in 1917 was about 88,200,000 pounds, valued at about $24,000,000. This is less than the production in 1916, which was 119,600,000 pounds, valued at $29,484,000, but is greater than the production of any other year. The reduction in output was due largely to labor troubles at the Kennecott-Bonanza mine. During the year 17 copper mines were operated, compared with 18 in 1916–18 in the Ketchikan district, 6 in the Prince William Sound district, and 3 in the Chitina district. The enormous output of the Kennecott-Bonanza mine, in the Chitina district in 1917 as in previous years, overshadowed that from all others.

MILITARY MEDICAL RESEARCH IN FRANCE UNDER THE RED CROSS WAR COUNCIL

THE American Red Cross reports that the War Council has appropriated $100,000 for

general military medical research work in France, including special methods of recognition and study of diseases among soldiers.

This action followed a report from the Red Cross Commission in France to national headquarters as follows:

> An extraordinary opportunity presents itself here for medical research work. We have serving with various American units some of the ablest doctors and surgeons in the United States. Many of these men are already conducting courses of investigation which, if carried to successful conclusions, will result in the discovery of treatments and methods of operation which will be of great use not only in this war, but possibly for years afterwards. To carry on their work they need certain special laboratory equipment, suitable buildings and animals for experimental purposes. At present equipment and personnel can not be obtained through ordinary government sources without delay, which makes this source of supply quite impracticable.

The foregoing recommendation, like all others of a medical nature from the commission in France, was submitted to an advisory medical board in France composed of leading American doctors, working with our own forces in that country. They approved it.

This advisory board is headed by Dr. Joseph A. Blake, with whom are associated:

Colonel Ireland, of General Pershing's staff; Dr. Livingston Farrand, president of the University of Colorado; Dr. Alexander Lambert, professor of clinical medicine, Cornell Medical School; Dr. John M. Finney, professor of clinical surgery at the Johns Hopkins University; Drs. Richard P. Strong and W. B. Cannon, professors at Harvard University; Major George W. Crile, head of the Cleveland Base Hospital Unit; and Dr. Hugh H. Young, professor at Johns Hopkins University.

The committee in charge of this research work in France, headed by Dr. W. B. Cannon, professor of physiology at Harvard, includes:

Dr. Blake, Dr. Crile, Colonel Ireland, Dr. Alexander Lambert, Dr. Richard P. Strong, Dr. Kenneth Taylor, Dr. W. B. Cannon, professor of physiology at Harvard; Dr. Harvey Cushing, professor of surgery at Harvard; Dr. James A. Miller, professor of clinical medicine at Columbia; Dr. William Charles White, associate professor of medicine at Pittsburgh; and Dr. Homer F. Swift, professor of medicine at Cornell.

The question has been raised as to whether the appropriation for medical research was not outside the proper scope of Red Cross activity.

The answer is simple. The supreme aim of the Red Cross is to relieve human suffering growing out of war. The War Council was advised from the ablest professional sources available that an immediate appropriation for medical research would contribute toward that end. The War Council could not disregard such advice.

There are many unsolved medical questions of great importance in this war. Numerous problems relating to the treatment of wounds, the eradication of lice, fleas, and scabies, the treatment of trench nephritis, trench heart, war neurasthenia, exhaustion, lethal gases, shell concussion, wound infection, compound fracture, and a great variety of other diseases and injuries are still to be worked out. The solution of such problems will contribute not only toward the relief of suffering but toward more effective prosecution of the war. Scientific experience is conclusive that the most rapid possible approach to such solution is through medical research.

To safeguard expenditures under this appropriation it has been arranged that all applications for grants from it shall be made through the chief medical officer of the American Expeditionary Forces, Brigadier-General A. E. Bradley, and such recommendation is essential to consideration of such expenditure.

The following cablegram, signed by 41 medical officers on duty in France, was received by the American Red Cross:

> We believe the Red Cross has properly expanded its funds because it is the duty of the Red Cross to care for sick and wounded American soldiers, and to use funds to prevent those soldiers from being infected with the various diseases met with in their peculiar Army life. There are several diseases, the exact nature of which is still undetermined, as they are new and peculiar to this war and must be studied now to aid our troops. We

stand on the principle that Red Cross funds should back such work rather than secure special funds for that purpose.

The medical department of the United States Army is in full accord with all the Red Cross is doing in this regard. It is cooperating and assisting in every way in research matters, and is counting upon our help in this regard. It has asked the Red Cross to help it study the many problems of preventive medicines and of medical and surgical diseases, against which the Army Medical Corps must struggle. The research committee assists the Red Cross in the management of its funds and its experiments, and controls the type and kind of experimentation. The research commitee, whose names you have, controls fully its research work, against which the antivivisectionists are protesting.

English medical authorities are vigorously cooperating with the Red Cross in research work. We feel that any one endeavoring to stop the Red Cross from assisting in its humanitarian and humane desire to prevent American soldiers from being diseased and protecting them by solving the peculiar new problems of disease with which the Army is confronted is in reality giving aid and comfort to the enemy. Research work so far undertaken includes studies on anesthesia, shell shock and trench fever, which last will be the main line of investigation this winter. We are also investigating trench nephritis and foot-wound infections, including gas gangrene and tetanus. The animals used are principally guinea-pigs, rabbits and white rats. If operations causing pain to animals are performed anesthesia is used. Actually very few animals have been used for this work.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES DOOLITTLE WALCOTT, secretary of the Smithsonian Institution at Washington, has been elected corresponding member of the Paris Academy of Sciences in the section of geology in place of Sir Archibald Geikie, who has been elected foreign associate.

PROFESSOR ARTHUR N. TALBOT, of the University of Illinois, has been elected president of the American Society of Civil Engineers.

PROFESSOR WILLIAM TRELEASE, of the University of Illinois, who was chairman of the organization committee of the Botanical Society of America in 1893 and its first president in 1894, has been elected president for the year 1918.

CHANCELLOR SAMUEL AVERY, of the University of Nebraska, has been given leave of absence in order that he may go to Washington to accept the position of chemist with the National Council of Defence.

THE Norman medal of the American Society of Civil Engineers has been awarded to Benjamin F. Groat, hydraulic engineer of Pittsburgh, by the board of direction of the society. The medal is of gold and is awarded to a paper which shall be judged worthy of special commendation for its merit as a contribution to engineering science. The title of the paper for which the award was made is "Chemihydrometry and its application to the precise testing of hydroelectric generators." It appeared in the *Transactions* of the society for 1916. The name "Chemihydrometry" is one that was suggested by Mr. Groat in SCIENCE for June 11, 1915.

THE Royal Dublin Society has presented its Boyle medal to Professor J. A. McClelland, F.R.S., in recognition of his work in science, especially on ionization.

DR. HENRY JACKSON WATERS, for eight and a half years president of the Kansas State Agricultural College, resigned this position on December 31, to become managing editor of the Kansas City *Weekly Star*. During his administration, the college has progressed notably in the fields of education and research and has gained materially in financial support. Dr. Waters leaves the institution to enter a field in which he believes that there is a large opportunity for service to agriculture and one in which, at present, his talents can be used more effectively. Pending the election of a new president, Dean J. T. Willard, of the division of general science, will be acting president at the college.

CAPTAIN ANTON J. CARLSON, Sanitary Corps, National Army, now at the Army Medical School, Washington, D. C., has been directed to proceed to Ottawa, Canada, for the purpose of conferring with the surgeon general of the Canadian forces concerning the nutrition of

the Canadian Army. He will visit Montreal and Toronto to observe the food conditions of the concentration camps and will later inspect camps in the United States.

MAJOR FRANK BILLINGS, M.R.C., professor of medicine in the University of Chicago, who was appointed medical adviser to the governor of the state of Illinois, in the creation of the medical advisory boards, and who has been acting in this capacity, is now relieved from this duty and assigned to the Provost Marshal General's Office, Washington, D. C. It is understood that Major Billings' work in Washington will be that of adviser to the Provost Marshal, in connection with the medical problems under the Selective Service Law. Major Billings will report in Washington on February 1.

DR. EDWIN OAKES JORDAN, head of the department of bacteriology of the University of Chicago, returned on January 12, from Fort Sill., Okla., where has has been making a study of epidemic cerebrospinal meningitis.

DR. L. B. BALDWIN, superintendent of the Hospital of the University of Minnesota, has been commissioned as a major in the medical reserve corps of the U. S. Army, and assigned to the personnel division of the Surgeon General's office at Washington, D. C.

LAWRENCE MARTIN, professor of geography in the University of Wisconsin, has been commissioned a first lieutenant in the National Army.

THE University of Chicago has granted leave of absence to Associate Professor Carl Kinsley, of the department of physics, for work in the Radio Division of the Signal Corps of the United States Army, and to Professor Henry Gordon Gale, of the same department, who is now a captain of infantry in the United States Army.

DR. C. A. MAGOON, assistant professor of bacteriology at the State College of Washington, has resigned to accept a position in the Bureau of Plant Industry at Washington, D. C. His new field will be bacteriological investigations in connection with the problems of food preservation.

THE secretary for Scotland has appointed Mr. Charles Weatherill to be secretary to the Board of Agriculture for Scotland, in place of Mr. H. M. Conacher, who has been appointed a deputy commissioner of the board.

MR. WORTHINGTON G. SMITH, known for his publications on and especially for his illustrations of British fungi, died on November 1.

SIR WILLIAM H. LINDLEY, known for his work on municipal engineering, died on December 30, aged sixty-four years.

MAJOR HARRY CLISSOLD, teacher of natural science at Clifton College, England, has been killed in action.

THE annual meeting of the New York State Breeders' Association was held at Syracuse on January 8, 9 and 10. Addresses were given by President J. G. Schurman, of Cornell University, on "Food Problems, National and State"; by Dr. V. A. Moore, dean of the New York State Veterinary College, on "Control of Hog Cholera," and by Professor Mark J. Smith of the New York State College of Agriculture, on "Farm Flock Husbandry," and by Ernest I. White, of Syracuse, president of the New York State Association of Horsemen, on "Horse breeding and the war."

UNIVERSITY AND EDUCATIONAL NEWS

DR. THOMAS F. KANE, president of Olivet College, has been elected president of the University of North Dakota, to succeed President Frank L. McVey.

DR. CARROL G. BULL, of the Rockefeller Institute, who is now in France demonstrating with the French armies his newly discovered cure for gangrene, has been named as associate professor of immunology and serology in the Johns Hopkins School of Hygiene and Public Health.

THE board of regents of the University of Minnesota at their meeting on January 18, elected Dr. W. A. Riley, of Cornell University, professor of parasitology and chief of the di-

vision of economic zoology. Professor A. G. Ruggles was, at the same time, appointed station entomologist, which position carries with it the office of state entomologist. At the December meeting of the board Professor F. L. Washburn, who has held the position of state entomologist in Minnesota for nearly sixteen years, asked and obtained permission to be relieved of that position and its attendant police duties, and the action of the board on the eighteenth was necessary to fill the vacancy thus caused.

MR. D. C. DUNCAN, assistant professor of physics at Purdue University, has resigned his position to accept appointment in a similar capacity at the Pennsylvania State College.

E. G. WOODWARD, formerly head of the dairy department at the University of Nevada, has been made head of the dairy division, State College of Washington.

I. D. CHARLTON, professor of agricultural engineering at the State College of Washington, has resigned to accept a similar position at the University of Minnesota.

DR. WILSON GEE, professor of biology in Emory University, has resigned to become assistant director of agricultural extension work in South Carolina. His successor is Dr. R. C. Rhodes, formerly assistant professor of biology in the University of Mississippi.

PROFESSOR F. DE QUERVAIN has been appointed to the chair of surgery in the University of Berne in succession to the late Professor Kocher.

DISCUSSION AND CORRESPONDENCE

VITAMINES AND NUTRITION

IN this national food crisis when people are scrutinizing the make-up of their diet for patriotic, economic and physiologic reasons the proper selection of food materials looms up as a problem of no mean proportions. Especially is this true with those who, having attempted to keep abreast of the most recent developments in nutrition, have had their faith in former practises shaken by a smattering of knowledge of the importance of vitamines in the dietary. Truly, from the standpoint of the investigator, an appreciation of the rôle of vitamines has made and will make much progress in nutrition possible and in every way more complete, but from the standpoint of the people as a whole it is questionable if the possibility of a lack of vitamines in the diet is of more serious import than that of the lack of suitable proteins or mineral constituents.

Vitamines as a class are now acceptably divided into a fat soluble and a water soluble type. Both are absolutely essential in a complete diet and both vary considerably in their occurrence. Individually many foods are deficient in one or both of them, but safety has undoubtedly been assured to the consumer by his desire for variety. It is scarcely to be doubted that in the American diet there is probably no danger of a lack of sufficiency of the water soluble vitamine, but with the fat soluble type the case is not so clear. Up to the present, studies on its occurrence are limited to a few seeds and leaves, and fats of plant and animal origin. While butter fat is richer in this dietary essential than butter substitutes, it is still too early to predict if in the aggregate this special property of butter fat warrants its taking a superior place in the mixed diet. The fat soluble vitamine has recently been found in this laboratory to occur in liberal amounts in edible roots as compared with our cereal grains, but it has also been found to be quite easily destroyed—apparently by oxidation. The chemical stability of the dietary essential and its occurrence in various foods is now being studied in this laboratory to determine if there is any probability of a varied diet of raw and prepared foods being deficient in this constituent.

H. STEENBOCK
LABORATORY OF AGRICULTURAL CHEMISTRY,
UNIVERSITY OF WISCONSIN

A FLOOD IN THE VALLEY OF THE ORISKANY CREEK, NEW YORK

ON Monday, June 11, 1917, there occurred in central New York a flood which was remarkable in respect to the damage done in a very limited area, and the control of the waters by physiographic conditions.

Oriskany Creek rises in the southern part of Oneida county, flows south for three and one half miles, following the normal direction of the Chenango River drainage across the Madison county line, and one and one quarter miles west of the village of Solsville is diverted abruptly to the northeast, eventually emptying into the Mohawk River.

For the distance of a mile west, south and east of Solsville the main valley is a nearly level plain consisting of two glacial terraces, through which Oriskany Creek flows for nearly two miles in a narrow valley about fifty feet below the terrace level.

From Solsville to Oriskany Falls—nearly four miles—the stream is constricted within a valley only a few hundred yards wide for the greater part of the way, choked with kames which expand to the east and north into one of the larger kame areas of central New York. The stream is utilized extensively for water power, one pond being situated at Solsville and two others within a distance of a mile and a half to the east. The track of the Utica division of the New York, Ontario and Western Railroad follows the stream bed in this part of its course.

Due to severe and continued rain on the night of June 10, the three ponds mentioned broke their dams almost simultaneously about four o'clock the following morning. A wave of huge proportions rolled down the narrow valley destroying buildings and ruining crops in its path.

The village of Oriskany Falls is situated in the valley between a steep rock hill on the north and a large kame on the south. Fortunately the inhabitants were warned of the impending disaster by telephone. However, two persons were drowned. Leaving the village street the flood followed the sharp turn of the creek to the southeast, the waters in part flowing along the railroad track between a row of buildings and the kame, and washing away the railroad embankment near "the falls." At this point the railroad track was suspended in mid air for at least 100 feet to the bridge. The area devastated was estimated as one eighth of a mile wide in the village.

Three and one half miles north of Oriskany Falls, near the village of Deansboro, the same stream also washed out a railroad embankment for many feet.

The writer was staying in a neighboring town at the time and was an early witness of the scenes above noted.

H. N. EATON

STATE COLLEGE, PA.

SCIENTIFIC BOOKS

Laws of Physical Science. By EDWIN F. NORTHRUP, Ph.D. J. B. Lippincott Co. 210 pp.

The author of this volume has proposed to collect in compendious form the principal facts and relations that have been established in the study of physical science. The book does not pretend to be a text-book or to go into the discussion of the principles stated, but the attempt has been made to present all the more important laws and principles of physics in such form that they may be easily referred to by a student or worker in the subject, and to give in each instance references to sources where a fuller discussion may be found.

The plan has left the author great freedom of choice and he has browsed about, gathering here and there not only the more formal laws and wider generalizations, but facts, relations, and even definitions from all domains of physics including physical chemistry. No attempt is made to connect them into a systematic body or treatise beyond the arrangement of the various topics under the main divisions of the subject in something like logical grouping.

The large number of laws and relations given—there are about five hundred separate topics—makes it necessary for each statement to be brief and clear-cut, leaving the detailed explanation to be looked up by the student in the text-book or treatise to which reference is made. The demands of condensation have been met for the most part very successfully in statements which though compact are clear and correct. In a few instances, however, the

statements should be revised as in case of the gas constant on p. 79, where the reader would be puzzled if he did not understand that a gram-molecule of gas is the amount dealt with. Also we find quantity of heat defined as "the total kinetic energy of the molecule or ultimate particles of a body," without explaining that this excludes what is ordinarily called latent heat. In describing the Nicols' prism the spar is said to be cut along a "parallel plane" without indicating to what the plane is parallel. In the statement about vector potential the phrase "all lines of magnetic induction" is used where the meaning is, the total flux, or total number of lines of induction. Also the interior of a hollow enclosure at uniform temperature is spoken of as at "black body temperature" instead of as giving off the radiation characteristic of a black body at that temperature.

It is perhaps unfortunate that the author has chosen Rankine as his source for various thermodynamic statements, for with all his undoubted genius Rankine is not an easy guide to follow, and the two statements of the second law of thermodynamics which are quoted from him are practically useless unless interpreted by the fuller discussion in the original to which reference is given. We should have expected a more modern statement of so important a matter as the second law, to supplement the statement by Clausius which is given.

But it is easy to be too critical; the author has successfully carried out his proposal and has done an important service in bringing together in this convenient form so large a collection of the laws and principles of physical science, clearly and accurately stated, and in the care with which the specific references under each topic have been selected, making it easy for the student to turn to sources where the subject is more fully developed.

The volume is well gotten up, with flexible covers in handy form for reference, and has a full index. A few misprints are noted, as in formulas on pages 37 and 42, where the figure 1 is used instead of the letter l, also in the general equation for the flow of heat the coefficient of conductivity K is omitted, and in the formula for the frequency of vibration of a stretched cord the factor $2l$ does not appear.

A. L. Kimball

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The ninth number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

Heliotropic Animals as Photometers on the Basis of the Validity of the Bunsen-Roscoe Law for Heliotropic Reactions: Jacques Leob and John H. Northrop, Rockefeller Institute for Medical Research, New York City. New quantitative experiments proving that the "instinctive" motions of animals to light are phenomena of automatic orientation and a function of the light intensity, the function being the Bunsen-Roscoe Law of photochemical action.

The Appearance of Reverse Mutations in the Bar-Eyed Race of Drosophila under Experimental Control: H. G. May, Department of Zoology, University of Illinois. Such a phenomenon is not difficult of explanation on the theory that it is produced by a chemical change in the constitution of some substance.

The Part Played by Alcyonaria in the Formation of Some Pacific Coral Reefs: Lewis R. Cary, Department of Biology, Princeton University. On certain of the Pacific reefs the alcyonaria are important coral-forming agents; their relative importance can be determined only after borings have been made through some reefs to determine the history of the reefs.

Observations upon the Alkalinity of the Surface Water of the Tropical Pacific: Alfred Goldsborough Mayer, Department of Marine Biology, Carnegie Institution of Washington.

The Effect of Temperature on Linkage in the Second Chromosome of Drosophila: Harold H. Plough, Zoological Laboratory, Columbia University. Both high and low temperatures produce an increase in the percentage of crossing over. The crossing over appears to take place in the stage when the chromo-

somes are known to be finely drawn out threads, not in the early oogonial divisions nor in the late thick thread stage.

Genetic Factors affecting the Strength of Linkage in Drosophila: A. H. Sturtevant, Zoological Laboratory, Columbia University.

Further Evidence on the Concentration of the Stars toward the Galaxy: Frederick H. Seares, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

Theoretical Relations in the Interferometry of Small Angles: Carl Barus, Department of Physics, Brown University.

Inter-Periodic Correlation in the Egg Production of the Domestic Fowl: J. Arthur Harris, A. F. Blakeslee, and Wm. F. Kirkpatrick, Station for Experimental Evolution, Cold Spring Harbor, N. Y., and Connecticut Agricultural College, Storrs, Conn. The results make possible the selection of groups of birds of high annual egg production from the trap nest records of individual months.

Two Laws governing the Ionization of Strong Electrolytes in Dilute Solutions and a New Rule for Determining Equivalent Conductance at Infinite Dilution Derived from Conductivity Measurements with Extremely diluted Solutions of Potassium Chloride: Edward W. Washburn, Department of Chemistry, University of Illinois. In sufficiently dilute solution all uni-univalent salts of strong acids and bases obey the Mass-Action Law and all have the same ionization constant; the values of the mass-action expression for all such salts are identical, the identity persisting up to higher concentrations the more nearly the salts resemble each other.

On the Growth and Fecundity of Alcoholized Rats: E. C. MacDowell and E. M. Vicari, Station for Experimental Evolution, Cold Spring Harbor, N. Y. Both growth and the fecundity of the alcoholized is subnormal as compared with non-alcoholics.

National Research Council: Minutes of the Meeting of the National Research Council held on Thursday, April 19, 1917, in Rooms 42 and 43 of the United States National Museum, Washington, D. C.; Meetings of the Executive Committee.

The tenth number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

On the General Theory of Curved Surface and Rectilinear Congruences: Gabriel M. Green, Department of Mathematics, Harvard University. Preliminary announcement of the number of theorems in a field which seems to be promising.

A Contribution to the Petrography of Southern Celebes: J. P. Iddings and E. W. Morley, Brinklow, Maryland and West Hartford, Conn. Twelve analyses of lavas from Celebes.

On the Non-Existence of Nervous Shell-shock in Fishes and Marine Invertebrates: Alfred Goldsborough Mayer, Department of Marine Biology, Carnegie Institution of Washington. Corroboration of the conclusion that war shock is predominantly a psychic phenomenon and being hysteria can be cured by hypnotic suggestion.

Chemical Differentiation of the Central Nervous System in Invertebrates: A. R. Moore, Rutgers College, New Brunswick, New Jersey. In the cephalopod, caffein brings about hyperirritability of the cerebral ganglia, while camphor affects the stellar ganglia in the same sense. Atropin causes spasms in the squid, but inhibits the activity of the chromatophores. Camphor shows a selective action in the shrimp paralyzing the elements controlling backward swimming and exciting those controlling forward motion.

Proof of the Muscle Tension Theory of Heliotropism: Walter E. Garrey, Physiological Laboratory of Tulane University, and Marine Biological Laboratory, Woods Hole. Experiments show that the motion of animals to or from a source of light are due to an influence of the light on the tension of muscles of different sides of the body.

Changeable Coloration in Brachyura: W. H. Longley, Goucher College, Baltimore, and Department of Marine Biology, Carnegie Institution of Washington. The colors of crabs and their capacity to change them vary from species to species according to the same general rule that appears to prevail among fishes.

The Equilibrium of Tortugas Sea Water with Calcite and Aragonite: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington. The surface water of the sea is the supersaturated solution of $CaCO_3$ and it is only necessary to introduce calcite crystals in order to cause precipitation of this substance.

An Oenothera-Like Case in Drosophila: Herman J. Muller, The Rice Institute, Houston. Report of an extended series of experiments showing that it will not do to accept evidence apparently in favor of factor inconstancy without the support of highly rigorous factorial analysis.

Is Death from High Temperature due to the Accumulation of Acid in the Tissues? Alfred Goldsborough Mayer, Department of Marine Biology, Carnegie Institution of Washington. Death is probably due rather to the formation of acid than to coagulation of proteid substances.

National Research Council: Meetings of the Executive Committee.

EDWIN BIDWELL WILSON
MASS. INST. OF TECHNOLOGY

SPECIAL ARTICLES

THE DETERMINATION OF ATOMIC WEIGHTS BY MEANS OF X-RAYS

IT does not seem to be generally realized that the recent developments in the study of crystal structure by the use of X-rays afford a method of determining atomic weights which may be of considerable value.

From the spectra obtained by exposing crystals of two different substances to X-rays of the same wave-length, the ratio of the distances between adjacent layers of atoms in the two substances can be easily determined, as is well known. If the relative distances are determined in the direction of each crystal axis, these results, together with the inclination of the axes to each other in each crystal, enable one to calculate the ratio of the volumes of the elementary parallelopipeds of each crystal. From this ratio and the ratio of the densities we can easily calculate the ratio of the molecular weights. From the ratios of molecular weights, atomic weights can be calculated in the usual manner.

This method requires the preparation of elements or compounds in a state of purity; the production of crystals of practically perfect internal structure, though not necessarily with perfect faces, or of large size; and the measurement of densities and spectral angles and, except when the crystal axes are mutually perpendicular, the measurement of the angles between axes. All of these measurements can be made with considerable accuracy.

Most of the measurements of the angles of X-ray spectra that have been made hitherto have not been highly accurate, for such measurements have been used principally for the determination of the relative positions of atoms in crystals, and for this purpose great accuracy is not required. It appears, however, that sufficient accuracy might be obtained to permit the determination of atomic weights with greater accuracy than that of most of the chemical determinations, and perhaps such accuracy has been obtained with recent spectrometric apparatus.

We are accustomed to think of the density of a substance as being a rather variable quality, but very few density measurements have been made upon perfectly pure material in the form of crystals of perfect internal structure. Very many materials, including metals, are handled commonly in the form of masses composed of a great number of small crystals, which, even if they consist of pure material, are likely to be very much distorted, and at the surface between two crystals there must be a layer of atoms many atoms deep which are not located exactly according to the space lattice of either crystal. There appears to be no reason why the density of a flawless crystal of pure material should not be quite definite, except that the surface forces might cause a difference in density near the surface, as the result of which the mean density might depend somewhat upon the size of the crystal.

After suitable apparatus had once been set up this method should permit the determina-

tion of the atomic weights of a considerable number of elements with less consumption of time and in most cases with greater accuracy than the chemical methods that have been used hitherto.

C. W. Kanolt

Bureau of Standards,
Washington, D. C.

THE MATHEMATICAL ASSOCIATION OF AMERICA

The third annual meeting of the Mathematical Association of America was held at the University of Chicago on Thursday and Friday, December 27–28, 1917, in conjunction with the Chicago Section of the American Mathematical Society. There were 119 in attendance at this meeting, including 93 members and one institutional representative. The program is given herewith:

PROGRAM

Thursday

The graph of $f(x)$ in line-coordinates for complex numbers, Professor A. F. Frumveller, Marquette University.

On the generalization of the witch and the cissoid, Professor F. H. Hodge, Franklin College.

Fermat's method of infinite descent, Professor W. H. Bussey, University of Minnesota.

On the disciplinary and applied values of mathematical study, Professor C. N. Moore, University of Cincinnati.

On the content of a second course in calculus, Professor E. J. Moulton, Northwestern University.

Address: *Descriptive geometry and its merits as a collegiate as well as an engineering subject*, Professor W. H. Roever, Washington University.

Brief discussions by Professor F. Higbee, department of descriptive geometry and drawing, State University of Iowa; Professor A. V. Millar, department of drawing, University of Wisconsin; Professor Arnold Emch, department of mathematics, University of Illinois; Mr. Willard W. Ermeling, instructor in descriptive geometry, Crane Junior College, Chicago; Mr. W. F. Willard, instructor in drawing, Carl Schurz High School, Chicago. General discussion.

Friday

Report of standing committees.

Committee on Mathematical Requirements.

Scientific investigations of the committee, Professor A. R. Crathorne, University of Illinois.

The work of a committee representing the Central Association of Science and Mathematics Teachers, Mr. J. A. Foberg, Crane Junior College, Chicago.

Committee on Libraries.

A report of this committee was published in the October *Monthly*.

Discussion opened by Professor H. E. Slaught, University of Chicago.

Committee on Mathematical Dictionary.

Preliminary report by the chairman, Professor E. R. Hedrick, University of Missouri.

Committee on *Annals of Mathematics*. Report by Professor E. H. Moore, University of Chicago.

Committee on Bureau of Information. Report by Professor J. B. Shaw, University of Illinois.

Joint session of the Mathematical Association of America and the American Mathematical Society.

Retiring address of the chairman of the Chicago Section of the Society: *A conspectus of the modern theory of divergent series*, by Professor W. B. Ford, University of Michigan.

Address on behalf of the association: *On a definition of the real number system by means of infinite decimals*, by Professor L. D. Ames, University of Missouri.

Seventy-three attended the joint dinner of the society and the association at the Quadrangle Club on Thursday evening, and a good number of the members attended the dinner of the American Association of University Professors on Friday evening.

At the annual business meeting amendments were adopted according to which the office of managing editor is divided into those of editor and manager, and the office of secretary-treasurer is to be filled through appointment by the council rather than through election by the association. Twenty-four persons and three institutions were elected to membership. The report of the secretary-treasurer showed that the association is appropriating a substantial subvention to the *Annals of Mathematics* in return for the addition to each volume of this journal of one hundred pages or more of articles of an expository or historical nature; that one hundred dollars has been set aside to cover some necessary expense in the work of the National Committee on Mathematical Requirements; that the year's business shows a gain of approximately one hundred dollars.

The following are the officers for 1918:

E. V. Huntington, Harvard University, President.

D. N. Lehmer, University of California; J. W. Young, Dartmouth College, Vice-presidents.

W. D. Cairns, Oberlin College, Secretary-Treasurer.

Committee on Publications: W. H. Bussey, University of Minnesota; R. D. Carmichael, University of Illinois, editor; H. E. Slaught, University of Chicago, manager.

Members of the council (for three years): Florian Cajori, Colorado College; Elizabeth B. Cowley, Vassar College; G. A. Miller, University of Illinois; E. T. Wilczynski, University of Chicago.

W. D. Cairns,
Secretary-Treasurer

SCIENCE

FRIDAY, FEBRUARY 8, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE FUTURE OF AGRICULTURAL EDUCATION AND RESEARCH IN THE UNITED STATES[1]

EDUCATION and research in the interests of agriculture have become important factors in the daily thought and activities of this nation. Those of us who saw the beginnings of the great educational movement which had its inception during the Civil War now contemplate its magnitude and influence with a feeling akin to that of amazement. More than one hundred land grant colleges and agricultural experiment stations are now in active operation, which were manned under pre-war conditions by over 7,000 administrative officers, teachers and investigators, using a combined income of over twenty-five million dollars and instructing between forty and fifty thousand students, besides carrying on extensive lines of research. More than all this, as a by-product of the Land Grant Act of 1862, a great system of popular education has been organized and Farm Bureau agents and extension teachers are now in touch with a large majority of our farming people.

This new movement in education, generally spoken of as vocational, which was regarded in its earliest days as a dangerous innovation, has not only attained a remarkable development, but has without question exercised a modifying influence over the educational policy and methods of the older universities and colleges.

That these institutions have performed

[1] Vice-presidential address before Section M. American Association for the Advancement of Science.

an indispensable function in our educational system is now generally conceded. They are now firmly imbedded in our governmental policy and receive an almost unanimous support.

Notwithstanding all this we are now questioning concerning the future of agricultural education and research. Are these efforts so directed as to most fully serve public welfare? Will the ideals which have dominated them and the aims to which they have been directed in the past meet future needs? Do the shafts of ridicule, often directed at what has been termed mind culture, and the insistent assertion that education fails to meet modern needs unless it serves some practical end, proceed out of a sound philosophy? Maintained as these colleges and stations are under a popular form of government and subject to the reactions of political changes and the vagaries of the public mind, do we see any indications that their efficiency is menaced? Existing as they do, in what we sometimes fondly call a democracy, will education and research in the interest of agriculture develop the high standards of efficiency that are reached by privately endowed institutions?

The fact that the agencies in question have developed to great magnitude does not spell efficiency as directed to given ends. Efficiency in education and research depends largely upon factors not measurable in terms of extensive equipment, large faculties or great bodies of students.

The question of the permanency of the agricultural colleges and experiment stations need not arouse solicitude. The teachings of these institutions are too firmly embedded in agricultural thought and practise, and the rural people are too dependent in technical and difficult matters upon the body of knowledge that has been, and is still being, developed, for their guidance to permit even a suggestion that agencies so useful will be allowed to lapse or lessen their activities. It must be conceded, too, that our experiences during the past two years have strengthened the confidence of the people in the colleges and stations. We can not fail to be impressed by the fact that a large number of men and women have been trained in these institutions to perform exactly the service now demanded in maintaining and directing our agricultural resources. It is gratifying to note also that many positions of responsibility in relation to food production and conservation are filled by graduates of the colleges of agriculture.

More than this, the large body of knowledge that has been collected and organized, which relates fundamentally to crop production and to the defense of the farmer and fruit-grower against the ills which beset them has greatly strengthened our grasp of the questions related to food production and conservation at a time when our resources are under a severe strain. Without these trained men and women and the knowledge gained through investigation and instruction in the interests of agriculture, it is difficult to understand how we could meet as successfully as we are doing the tremendous problems imposed by the war. We need not fear, then, that agricultural education will take a lesser place in our national life, but rather we may expect it to develop to meet larger needs, provided it is wisely directed.

The problem which should have our most careful thought and consideration is that of efficiency as related to the real functions which the colleges and stations should perform. As has been suggested, an elaborate physical equipment, generous endowments and subsidies, extensive laboratories and crowded classrooms—even

popular approval—do not of themselves indicate a wise educational policy. The great essentials of educational efficiency are intangible, and are found in the aims toward which the organization and activities of the colleges and stations are directed. In the case of state-supported institutions efficiency may also be promoted or hampered in a large measure by the conditions which are created through legislation and through the rules and regulations of related administrative departments, whether national or state.

Before proceeding further in our discussion, let us bring before our minds some of the essential purposes of agricultural education and research and the conditions that should be established within the institutions concerned, in order that this great national adventure in education, so generously endowed from public funds, shall not attain less than the largest possible results.

Without doubt, we can all agree to the statement that agricultural education and research should include in their scope fundamental purposes common to all education and research. No attempt at education in any direction is worthy of a place in our civilization which does not intensify in the individual a sense of his obligation to promote public welfare, elevate his moral and intellectual quality and in so doing enlarge his life opportunities and increase his efficiency for community service and individual attainment. No research is worthy of support that is superficial and trivial and in failing to arrive at fundamental truth and sound conclusions establishes an unsafe basis for practise. This means that agricultural education and research must be dominated by the ideals, infused with the spirit and strengthened by the conditions, that past experience has shown to be essential to the advancement of knowledge and to the training of young men and women for the largest usefulness. The subject-matter and the tools of education and research may change, but the point of attack of the teacher and investigator should be the development of patriotic impulse, sound knowledge, elevated human character and individual efficiency and through these results promote human welfare. The influence of education is reflected chiefly in its product of truth and trained minds.

It is for these reasons that some of us hold that the great and insistent problems of the colleges of agriculture are not primarily related to institutional participation in the social and economic reorganization of rural communities, but are concerned first of all with the training of young men and women. It is a serious question whether these colleges have not expended energy and means in educational propaganda which could more wisely have been applied to increasing internal efficiency. There are many reasons for holding that community life will reach a sound and enduring social and economic status only when its progress is self-initiated and self-directed and possibly we shall sometime discover that this very laudable impulse on the part of institutions to be of public service has been carried too far in attempting to impose rapidly upon the rural people conditions that can only be reached through that gradual education and development attained in no other way than through community effort.

The avenue through which agricultural education and research will react upon community life most effectively will not be elaborate platform and literary propaganda, but the continual personal contact of the people with minds adequately trained for leadership. If this be so, then the product of the colleges should be leaders. Do you say this is obvious? Grant-

ing that it is, we may now inquire as to the directions in which leadership is most needed.

When the land grant colleges first came into existence, the thought forced to the front, which has gripped the public mind ever since, was that agricultural education had for its function growing the extra blade of grass through the enlarged vocational efficiency of the farmer. Directed by this conception of its main purpose, the college of agriculture has in many instances been severely commercialized. Because of the changes that have arisen in our social and economic conditions and the increase of agencies established for the promotion of agricultural progress, the time has now come when we must ask the question whether the ultra-practical point of view so widely prevalent among agricultural teachers is the one that will fully meet the developing situation.

We are obliged to abandon the notion, if we ever held it, that these colleges will train within their walls any large proportion of the men and women that will live on the land. On the other hand, we must take practical cognizance of the fact that the by-products of the college, such as agriculture in the high schools, extension teaching and farm bureaus, are the agencies that are now touching farmers and farm homes in a more intimate way than was ever possible by the college and are accomplishing much that in earlier days the college was expected to do. There is now an unfilled demand for the highest type of leadership in these and other directions. This leadership, if it satisfies the demands that confront it, must be much more than merely technical and vocational. The future of the rural people is now greatly concerned with factors other than larger production.

It is increasingly evident that the social environment of the farm and the broad economic conditions to which the farmer is now related, in the determination of which he must be a factor, must now receive major attention. It is not exaggeration to declare that the social organization of a rural community and the extent to which farmers successfully meet competing interests are now determinative factors in agricultural welfare and progress. The educational policy which is concerned chiefly with the problems of larger and cheaper crops will come far short of meeting the situation adequately. If these colleges of agriculture are to aid in developing men capable of the needed leadership, must they not lay the foundation in their graduates for the intelligent and successful consideration of the broad questions relating to rural sociology and economics? Should not these graduates become leaders of thought in all that pertains to community welfare and progress? The question then is, Do a majority of the colleges of agriculture adequately provide training of this type?

Having outlined a type of leadership now demanded for agricultural progress, we may now consider what should be the policy of the colleges of agriculture as related to the subject-matter of the courses of study and to the point of view established in the minds of the students through contact with their teachers. There has been more or less prevalent what some of us regard as a convenient fallacy, comforting, perhaps, to those who cater to popular notions as to what is practical in education, that a study of the sciences as applied to the various phases of agricultural practise and engaging the mind with such ultra-practical subjects as judging corn or cattle, making butter and cheese, orchard culture or poultry keeping, completes the round of the training essential to the agricultural college graduate and that in the interests

of vocational efficiency the severer ranges of thought involved in the study of the fundamental sciences, mathematics, economics, civics, psychology, language and literature should be reduced to a minimum. Can any one of us who has traveled the academic road and recalls the varying reactions upon his intellectual vision and equipment of the several subjects which engaged his attention as a student believe this is the needed training for such leadership as is demanded? Ask graduates from ultra-practical courses of study who have entered the service of a college or station, or who have attempted leadership in a rural community, how they regard this matter and you will get enlightenment from those whose experience justifies an opinion as to the adequacy of their undergraduate training. They will tell you, as many of them have told others, that they are called upon to enter into ranges of thought and to meet problems for which the college did not even lay the foundation of an adequate preparation.

Insistent questions arise just at this point. Can we reasonably speak of vocational efficiency or efficiency in any direction as apart from intellectual efficiency? Are technical expertness and practical facts a substitute for the development of the reasoning powers and the establishment of a sound basis on which to rest conclusions? For the future citizen, will the ability to judge a steer take the place of ability to judge a political candidate's civil and political theories? As a factor in the economic success of a rural community, will a knowledge of fertilizers take the place of wise plans for the disposal of the crops produced? For a human being whose life will be less than a success if he accomplishes nothing more than vocational prosperity and does not enter effectively into the problems of community welfare, which is worth the most—ability to think clearly concerning human conduct and relations or mere expertness in farm management? Is anything a substitute for the development of high ideals of conduct and a clear understanding of human relations? In short, what are the major objects of human living and in what way can education serve these? Is the educational policy of our land grant colleges sufficiently directed toward the larger issues of life? Is it not entirely possible that the education provided at these institutions has become too material and commercial, and that we need to pause and consider whether vocational success without human efficiency is a result greatly to be desired? These are questions for serious thought and they now demand our attention.

If we accept the view, as obviously we must, that the mentality of a man or woman is a dominating factor in his or her human value and individual success, then we should carefully scrutinize the relation of the subject-matter of the college classroom to the development of intellectual acumen and vision. We may make a grievous error if we too fully abandon what is termed the cultural point of view in education and fail to nourish the intellect and to establish with our graduates a basis for correct and sound thinking regarding the broad relations of life. It will be a fatal error if we allow the demand for commercial advantage to cause us to ignore the need for soul and mind culture. Should we not, therefore, revert to some extent to the older and somewhat abandoned point of view held by the earlier educators that the function of the college is to establish with the student not so much a mass of facts as the ability to deal with facts?

Putting these questions in another form, we ask whether the ultra-practical course of study is not a mistake and whether the

college that retains to the largest possible degree an association with the fundamental sciences—those subjects traditionally spoken of as the "humanities"—especially those relating to social and economic conditions is not pursuing a wise policy? Some of us are convinced that conditions of expediency, based on popular demand, have led the agricultural colleges too far afield in what has been termed practical training.

At this point it may be asked, from whence shall come specialists for teaching and investigation in the fields of agronomy, agricultural biology, horticulture and animal husbandry if not from the agricultural colleges, and would not the injection into the curriculum of a larger proportion of the so-called general culture studies crowd out much that is essential to the technical courses and defeat, in part, the objects for which the colleges were created?

This question suggests others. In practise are the graduates from the prevalent agricultural courses found to be fitted to teach or investigate? Do they not soon discover, or at least, do we not discover for them, that the higher ranges of service, whether in the classroom, laboratory or in the field, demand broader and deeper vision than they possess, which must be acquired through a subsequent severer and more extensive training? Are we not in many instances turning to the graduates from the older universities for members of college faculties and station staffs? Why not then give to the student a broad educational foundation, with special attention to some line of science applied to agriculture and make him understand that to be a capable teacher, investigator, publicist, or even the most useful member of a rural community, all this and more is required. We should not be satisfied to bring into contact with our students or accept in our station staffs men and women who are mere specialists and whose influence over the student's mind and in the station community ceases with imparting or gaining a knowledge of certain practical facts. Because the value to young men or women of their college experience arises to a great extent from their contact with teachers of broad vision, large understanding and an active sympathy with life problems, we should adequately prepare the teacher for this high function and great responsibility.

But you ask, what about the young men and women who go from the college to the farm and farm home? Considering the kind of service now demanded in rural communities, the need for leadership guided by the ability to reason from fundamental facts and principles and by an understanding of social and economic relations, is far greater than the need for mere expertness in fertilizing the land, feeding animals or spraying fruit trees, howsoever important these may be. For this reason let us train at least some young men and women to meet this need even if they must learn through postgraduate experience certain practical facts to which an ultra-practical course of study would give attention. To-day the human problems are the big problems. On its social and economic environment the future of the farm largely rests, and the average rural community sadly lacks leadership that is something more than vocational. In brief, then, the agricultural colleges should not establish entrance requirements and curricula chiefly with reference to turning out practicians, but should give prominent consideration to training men and women for effective agricultural leadership. Such men and women, inspired by a zeal for service, are needed in our legislatures, even in our national legislature; they are needed as publicists and in close and constant

touch with the life of rural communities.

So far we have discussed some of the aims to which it is argued the agricultural college should direct its attention. Let us now consider the aims of the experiment station. If asked what they are, we might answer with the brief phrase—scientific research in the interests of agriculture. No answer is adequate, however, which does not include an interpretation of the term research. Should this interpretation be based upon the projects undertaken by experiment stations, we would surely arrive at a state of perplexity for it would include everything from severe laboratory inquiry to loosely conducted experiments having no possible outcome other than an answer to narrow business questions, possibly only local in their scope.

If the members of this Section now expect to hear a criticism of the past, they will be disappointed. It is much wiser to consider future efficiency, because in former discussions the mistakes of the past have been laid bare. Many of them were almost inevitable mistakes, incident to the rapid development of a new effort, especially under the coercive influence of public expectancy reacting upon legislative attitude. May we not, however, be permitted to indulge in criticism having a constructive purpose even though nothing new in the way of suggestion be offered.

The decision as to whether an alleged scientist is conducting research worthy of the name should depend upon the method or plan under which he is working and the quality of the effort applied to the problem and not upon the title of the project. An experiment station may state that it is studying problems of soil fertility, but if it is doing this merely by means of field experiments directed to determining the relative profit from different methods of culture without at the same time studying as exhaustively as possible some one or more of the biological, chemical or physical factors contributing to the result but little or no real progress will be made. Our understanding of animal nutrition has not been the result of practical feeding experiments to any important extent but has developed out of studies of metabolism with the respiration apparatus and other refined methods. Instances of the futility of ultra-practical experiments as a means of arriving at basal facts and principles could be cited in great number.

One suggestion that reasonably applies to the whole range of agricultural research and which if followed more generally would undoubtedly result in greater investigational efficiency, is that experiment stations should confine their studies to the narrow individual factors that are involved in agricultural production rather than driving directly at broad generalizations or answers to business problems which include the operation of many factors. The history of agricultural science shows clearly that only in this way has substantial progress been made.

In discussing the efficiency of agricultural research in the United States our attention should not be confined wholly to the experiment stations but should also be directed to the largest single effort of this kind now supported by public funds. Doubtless what will now be said will be taken as a criticism and it is intended as such, not of individuals but of a situation which has grown up under what must be regarded as a mistaken policy. Reference is made to activities in the Federal Department of Agriculture classified as agricultural investigation that occupy the time of a large number of men and against which are charged annually millions of dollars of expense. While it is recognized that this department has made many

worthy contributions to agricultural science, it may safely be asserted that the conditions under which the scientific efforts of the department are conducted are not those which most fully inspire and nourish the research spirit or permit the most effective and economical application of time and energy to the study of problems. This is due to the fact that many of those persons who are expected to be fruitful in scientific results are so inextricably entangled with the distractions attending propaganda and administrative duties that the essential repose of mind, opportunity for study and reflection and continuity of effort, are not possible. The opinion is entertained by those familiar with the situation that until research efforts supported by, and maintained within, the Federal Department of Agriculture are separated from their present environment we may not expect the most efficient application of thought and energy to scientific studies.

So far we have dealt chiefly with questions of the internal policy of the agricultural colleges and experiment stations. Let us now turn to a consideration of the influence of certain external conditions of the nation and states.

A movement has developed during the past few decades which is of great significance to national and state-supported institutions and is regarded by those who have come under its domination as a menace to the efficiency of agricultural education and research. Reference is made to the marked tendency toward the centralization of directive authority over institutions maintained by public funds. It is evidently being assumed that greater efficiency and economy of energy and funds will result if upon the management of such institutions is superimposed through the authority of a department, bureau or commission, national or state, control that is essentially administrative in character. Evidently it is now assumed that it is more or less dangerous to leave with the management of certain national or state-supported institutions the liberty heretofore regarded as essential to successful administration, especially of education and research. In a few states where this movement is most marked, administrative officers have come to speak of themselves as "rubber stamps." The officers of certain of our colleges and stations surely must realize that they have lost their official autonomy to a considerable degree and that they should not be regarded as wholly responsible for the policy and conduct of the institutions over which they have charge. Is there any justification for this? Does it arise in the conviction that the colleges and stations have adopted wrong policies, employed incompetent men or wasted public funds? So far as can be discovered, it does not originate in charges of this nature.

Before discussing this situation in detail, let us outline what are the conditions essential to the successful direction and maintenance of education and scientific research. It is generally agreed that these are freedom of administrative initiative, such organization and relations as are stimulating both to the teacher and to the research worker and the possibility of maintaining a continuous policy in the conduct of any institution that is organized for the purposes named. A college or station must have a staff of workers, and its management should be at liberty to employ and develop this staff without let or hindrance within the limits of its financial resources. No regulations should be imposed which prevent the retention of satisfactory service on a salary basis consistent with the costs of living or which makes it impossible to meet in a reasonable way the competition for efficient teachers and in-

vestigators which is now so keen. These institutions must have funds, but they should be provided under regulations which do not constitute a barrier to the accomplishment of the ends for which they are established.

The relation of the federal government to the agricultural colleges and experiment stations which it is subsidizing has been the subject of much discussion and the occasion of more or less anxiety on the part of state officials. The congressional acts making possible the establishment of the land grant colleges, whether the first Morrill Act donating public lands to the several states or later acts making appropriations of money, placed few restrictions upon the several states accepting the terms of these acts. Each state has been allowed to organize and develop its college of agriculture without outside interference and while mistakes have been made and the expenditure of funds has been more or less wasteful, the result has been that these institutions have been developed and adjusted in accordance with the needs and conditions of the states in which they were located. It is probable that had the federal government attempted a centralized direction of this new enterprise the results would not have been as satisfactory as those which have been reached.

The original legislation establishing agricultural experiment stations and the acts subsequent thereto materially increased federal supervision. This is especially true of the terms under which the appropriations made by the Adams Act are applied to agricultural investigation. The Department of Agriculture requires not only that the various projects which the institutions propose to undertake shall be filed with the department for its approval, but it inspects the work and accounts of the several experiment stations to determine whether the funds have been expended in accordance with the enabling act and solely for the study of the projects which have been filed. No fault can be reasonably found with the attitude of the federal government in ascertaining whether or not the money it appropriates is properly and legally expended, and there appears to be no disposition to chafe at the supervision now exercised by the national Department of Agriculture over the use of what are known as the Hatch and Adams Funds.

Later legislation, known as the Smith-Lever and the Smith-Hughes Acts, providing respectively for the extension of agricultural knowledge in a popular way among the people and for industrial education in our secondary schools, requires still closer supervision of the use of federal funds and of the plans proposed by the several states for the carrying out of these efforts. It is in these latter acts that federal supervision is regarded by many as having approached the danger point. This anxiety has been caused not so much by what is now the federal policy as by the future possibilities under the provisions of the acts named. It is felt that the direction of these educational efforts should have been confided more fully to the several states, other than a proper auditing of the expenditure of funds, and that too much leeway is given to the individual judgment of federal officials. There is certainly danger from more or less loosely defined directive authority that a governmental department or bureau may exercise, whether state or national, over education and research because our political system makes possible frequent changes in administrative staffs, and the maintenance of a consistent and uniform policy is thus endangered.

It is not intended in what is being said to criticize individuals, but to call atten-

tion to the dangers under our form of government of centralizing authority in departments or bureaus distantly located, and necessarily not closely informed concerning the institutions over which they may exercise supervision.

The situation in some of our states is an occasion for real alarm, for what is known as the budget system now threatens the efficiency of agricultural education and research. Undoubtedly such a system should be applied to the financing of the nation, the states, public utilities and even private enterprises, but a fiscal policy may be carried to such an extreme that it becomes burdensome and even tyrannical and defeats its own objects. To illustrate: in certain states legislative budget committees fix salaries for the various positions in the colleges and stations and establishes an expense budget for these institutions segregated into numerous items, and no deviation is allowed from either salary or expense items, no matter what exigencies may arise. As a rule, the members of these committees have no intimate knowledge of the operations of the institution with whose interests they are dealing and on the basis of a hasty judgment not fully informed may establish salaries and expense items in such a way as to greatly hamper institutional progress. It is absurd for a college president or the director of a station when taking on a new man at a low salary to be unable to give him any assurance that continued efficient service will result in improving his financial status. It is even more absurd if a call to go elsewhere is given to some member of a teaching or investigational staff for the president or director to be unable to retain his services when it would be economical and wise to do so by the addition of a few hundred dollars to his salary. It is perplexing, sometimes embarrassing, and sometimes the occasion of vigorous language, for an institution to have its work set to a fixed financial scheme which does not fit the demands upon it. No prophets, ancient or modern, were ever called upon for a more difficult task than the filing of a statement with a legislative committee as to just how much money will be needed for traveling expenses twelve months in the future or how much it will cost to maintain a herd of cattle or run an automobile.

Those of you who are abiding in peace and comfort with a broadly segregated budget as, for instance, a lump sum for salaries and a lump sum for expenses, may think that these somewhat strenuous remarks concerning centralized control and an embarrassing bureaucracy are out of place. You should be assured, however, that this budget infection is spreading and that when one state adopts a new fiscal scheme other states are inclined to fall in line. Do not rest too quietly in your present liberty. The time may come when over yourself will be your board of control, and over your board of control a bureau, and over that bureau a committee, and over that committee the legislature, each division of authority feeling the responsibility of directing subordinate interests. There is every reason to fear that if present tendencies toward the closer control of our agricultural and research institutions by committees and bureaus is not checked, efficiency in education and research will abide only with privately endowed institutions.

Whitman H. Jordan

SCIENTIFIC EVENTS

COMMITTEE ON THE BRITISH CHEMICAL TRADE

The committee appointed by the Minister of Reconstruction to advise as to the procedure which should be adopted for dealing with the

chemical trade has now concluded its deliberations and issued its report, the following account of which is given in *Nature*. The committee was appointed (1) to advise as to the procedure which should be adopted by the Minister of Reconstruction for dealing with the chemical trade; 2 to consider and report upon any matters affecting the chemical trade which could be more effectively dealt with by the formation of special organizations for the purpose, and to make suggestions in regard to the constitution and functions of any such organization.

The members of the committee are: Sir Keith W. Price (chairman), Mr. John Anderson, Mr. J. F. L. Brunner, Dr. Charles Carpenter, Professor J. G. Lawn, Sir William Pearce, Mr. K. B. Quinan, the Right Hon. J. W. Wilson, and Mr. G. C. Smallwood (secretary). The committee says that it is evident that during the process of reconstruction numerous difficult problems and questions are likely to arise in connection with the chemical trade. The committee is of opinion that these can be satisfactorily settled only by the closest collaboration between the Minister of Reconstruction and the representatives of the trade, and it appears to be necessary that the minister should be in a position to obtain the views both of the trade as a whole and, in the case of particular problems, of that branch of the trade directly concerned.

This end could probably be attained in a satisfactory manner if there were in the chemical trade a representative body, which could advise the minister and act in a consultative capacity on chemical matters. Such a body should be fully representative of the whole of the trade, and the difficulty of the committee lies in naming an association which could be said completely to fulfil this condition.

The committee is of opinion that, in dealing with the chemical trade, the Minister of Reconstruction could properly act in collaboration with the Association of British Chemical Manufacturers. It is further of opinion that with a view to convenience of practical working, and in order to establish the permanent link which should exist between the ministry and the trade in all its branches, a standing committee should be established fully representative of all the interests concerned.

As to points of reference No. 2, the opinion is expressed that whatever may be the functions of the Ministry of Reconstruction, it will be necessary to establish a section of that department which will be in a position to deal with matters which may arise in connection with the chemical trade. The appointment to the Ministry of Reconstruction of a scientific man of good standing, who would command the respect and confidence of the trade, together with the necessary staff, is suggested. This section, working in conjunction with the standing committee previously mentioned, would provide the Minister with an adequate organization for dealing with such questions connected with the chemical trade. The following would represent some of the duties of this section:

(1) To ascertain with the assistance of the standing committee the chief problems which are likely to arise in the process of reconstruction after the war, and the best means of dealing with them. (2) To survey generally the chemical trade, both at home and abroad, and in consultation with the standing committee to afford advice for the broadening and improvement of the chemical trade of this country. (3) To collect and disseminate information on, and statistics of, the chemical trade. (4) To collect and collate as much information as is available on the work which has been done during the present war, which would, no doubt, be of great interest and assistance to the chemical trade as a whole.

The committee states in the report that it has confined its recommendations within the narrow limits defined by the terms of reference, which speak only of "chemical trade." If, however, for that expression were substituted "the national chemical industry," a much broader purview would be involved, and specific reference would be necessary to existing organizations other than those specifically founded for "trade" purposes, among which may be mentioned: The Society of Chemical Industry, the Government Laboratory, the

Committee of the Privy Council for Scientific and Industrial Research, the Imperial Institute, the National Physical Laboratory, and the Chemical Society.

It is recommended:

1. That in dealing with the problems of the chemical trade action should be taken so far as possible in the closest collaboration with representatives of the trade.

2. That the Association of British Chemical Manufacturers should be considered as representative of the chemical trade as a whole with certain branches excepted.

3. That a standing committee should be appointed. This committee, which should be fully representative of all the interests concerned, would establish a permanent link between the Ministry and the trade.

4. That a departmental organization should be set up in the Ministry of Reconstruction to deal with chemical questions.

IRON ORE IN 1917

The iron ore mined in the United States in 1917 amounted to about 75,324,000 gross tons, compared with 75,167,672 tons in 1916, an increase of 0.2 per cent. The figures for the two years are so nearly the same, however, that when the final returns are received from all the producers the actual quantity mined in 1917 may prove to have been less than that mined in 1916. The shipments from the mines in 1917 are estimated at 75,649,000 gross tons, valued at $236,178,000, compared with 77,870,553 tons, valued at $181,902,277 in 1916, a decrease in quantity of 2.9 per cent., but an increase in value of 29.8 per cent. The general average value of the ore per ton at the mines for the whole United States was therefore $3.12 in 1917, as compared with $2.34 in 1916. The stocks of iron ores at the mines apparently decreased from 10,876,352 gross tons in 1916 to 10,560,000 tons in 1917, or 2.9 per cent.

To obtain these statistics preliminary figures received from producers of nearly 95 per cent. of the normal output of iron ore were compiled under the direction of Ernest F. Burchard, of the United States Geological Survey, Department of the Interior, and were supplemented by estimates covering the remainder of the output.

About 85 per cent. of the ore mined in 1917 came, as usual, from the Lake Superior district, which mined about 63,964,000 gross tons and shipped 64,275,000 tons, these quantities representing a very slight increase and a decrease of 3.2 per cent., respectively, compared with 1916. The shipments of iron ore by water from the Lake Superior district, according to figures compiled by the Lake Superior Iron Ore Association, amounted in 1917 to 62,498,901 gross tons. It thus appears that the iron-mining industry in the Lake Superior district has been able to bear the strain of the war demand but not to duplicate the great record of ore shipments made by the district in 1916, which amounted to 64,734,198 gross tons. The slight falling off, it is understood, was due to less favorable weather for shipping early and late in the season of 1917 rather than to inability of the Lake fleet to handle the ore mined.

The South mined and shipped more than 8,100,000 tons of iron ore, the bulk of which was produced in the Birmingham district, Ala., but the iron mines of Georgia, Tennessee, North Carolina, and Virginia contributed about 1,400,000 tons to the total.

The Northeastern States—New Jersey, New York, and Pennsylvania—increased their production slightly as compared with 1916 and shipped to blast furnaces approximately 2,446,000 tons of ore. This quantity, however, represented decrease of 4.1 per cent. as compared with the shipments in 1916.

Colorado, New Mexico, and Wyoming, the principal iron ore producing States in the West, are estimated to have mined and shipped approximately 666,000 tons of iron ore, compared with 717,660 tons in 1916, a decrease of 7.2 per cent.

Other States, such as California, Connecticut, Iowa, Maryland, Massachusetts, Missouri, Nevada, Ohio, Utah, and West Virginia, in which there are small iron-mining operations, are estimated to have shipped about 144,000

tons of ore, compared with 134,002 tons in 1916, an increase of 7.5 per cent.

The imports of iron ore for the eleven months ending November 30, 1917, according to the Bureau of Foreign and Domestic Commerce, Department of Commerce, amounted to 913,500 gross tons, so that probably the imports for the whole year reached 988,500 tons, compared with 1,325,736 tons in 1916.

THE FISHERIES CONFERENCE

THE members of the Canadian-American Fisheries Conference held recently in Washington, were received by the President at the White House on January 22, 1918. The President expressed great satisfaction at the cordial and friendly spirit which had manifested itself during the continuance of the conference. The following gentlemen were presented to the President by Hon. William C. Redfield, secretary of commerce and chairman of the conference: Hon. J. Douglas Hazen, chief justice, of New Brunswick; Mr. George J. Desbarats, deputy minister of naval service, and Mr. William A. Found, superintendent of fisheries, of the Canadian delegation; Mr. Edwin F. Sweet, assistant secretary of commerce; Dr. Hugh M. Smith, commissioner of fisheries, of the American delegation; Mr. Arnold Robertson, first secretary of the British Embassy, and Mr. Maitland Dwight, of the department of state, secretaries of the conference.

The conference held eight sessions and made satisfactory progress toward reaching an arrangement suitable to all concerned. Among the questions discussed were the following:

The protection of the salmon in and around the Fraser River; the protection of the halibut, which has been overfished, the center of this industry being Seattle, Vancouver, Prince Rupert and Ketchikan, on the Pacific; equitable rules governing the use of Canadian and American ports by the fishing vessels of both countries, however propelled; the lobster fisheries of the Atlantic; pike-perch fishing in Lake Champlain, and the possible passage of rules relating to the whale industry.

The conference is looking forward to the privilege of consulting the fishing interests at the hearings which it is proposed to hold in New England and in the maritime provinces of Canada in the near future. It is also proposed to visit the Pacific coast, and it is hoped that these hearings will throw some light on the subject with a view to a satisfactory settlement being reached.

The whole conference is desirous of establishing the present law and practise as regards the fish industry, and believes that with this as a basis a satisfactory conclusion may be attained.

The Canadian delegates extended an invitation to the American delegates to visit Ottawa some time before the conclusion of the conference.

MEDICAL TRAINING CAMPS

EXTENSIONS are being made to the scope of the medical training camps at Fort Oglethorpe, Ga., and Fort Riley, Kans., by the addition of courses in specialties required of the Medical, Sanitary and Veterinary Corps under Surgeon General Gorgas. There are at present 5,400 officers and men under training at Fort Oglethorpe and 3,800 at Fort Riley. Fort Riley has a capacity of 7,000. Enlargement of the school at Fort Oglethorpe to the same capacity has been authorized, its present capacity being 5,500. The ultimate needs of the Medical Department of the Army look to training camps of capacities totaling 35,000 to 40,000 officers and men.

There have been graduated from medical training camps since June 1, or are now under instruction, a total of about 9,000 officers and about 20,000 enlisted men. Until December 1 the medical training camp at Fort Benjamin Harrison, Ind., and the one at Fort Des Moines, Iowa, for colored officers and men, had been contributing to the total, but these camps have been discontinued.

Ten new sections have recently been or are now being established for officers in the medical training camps. These are for the following:

(1) X-ray specialists; (2) orthopedic surgeons; (3) psychologists; (4) special examining surgeons; (5) sanitary engineers; (6)

veterinarians; (7) sanitarians; (8) hospital administration; (9) laboratory specialists (being established); (10) dental surgeons (being established).

Consideration is being given to plans for the establishment of three additional courses, one in general military surgery, one for genito-urinary surgery, and one for military surgery of the brain, head and face.

Various special groups now in active service have been trained since the opening of the schools. These include officers and men to operate ambulance companies, field hospitals, evacuation hospitals, base hospitals, hospital trains, etc.

SCIENTIFIC NOTES AND NEWS

Professor Fridtjof Nansen, of the University of Kristiania, Norway, now in Washington as Minister Plenipotentiary of Norway on special mission to the United States of America, has been elected an honorary member of the Washington Academy of Sciences. Dr. Nansen on January 31 gave an address before the academy on "Changes in oceanic and atmospheric temperatures and their relation to changes in the sun's activity."

Frank Austin Gooch, Ph.D., professor of chemistry and director of the Kent Chemical Laboratory of Yale University, will retire at the end of the present year. Professor Gooch will be succeeded by Professor Bertram Borden Boltwood, since 1910 professor of radio-chemistry.

At the meeting of the Ecological Society of America in Pittsburgh, officers for 1918 were elected as follows: *President,* Dr. Henry C. Cowles, University of Chicago; *Vice-president,* Dr. Robert E. Coker, Bureau of Fisheries, Washington, D. C.; *Secretary-treasurer,* Dr. Forrest Shreve, Desert Laboratory, Tucson, Ariz.

Dr. E. M. Freeman, dean of the college of agriculture of the University of Minnesota, was elected president of the American Phytopathological Association at the Pittsburgh meeting.

The officers of the Washington Academy of Sciences for 1918 are as follows: *President,* Lyman J. Briggs, of the Bureau of Plant Industry; *Corresponding secretary,* Robert B. Sosman, of the Geophysical Laboratory; *Recording secretary,* W. R. Maxon, of the National Museum; *Treasurer,* William Bowie, of the Coast and Geodetic Survey; *Non-resident Vice-presidents,* T. A. Jaggar, Jr., of Hawaii, and B. L. Robinson, of Cambridge; *Members of Board of Managers,* T. H. Kearney and A. C. Spencer; *Vice-presidents* representing the affiliated societies: G. K. Burgess, Philosophical Society; J. R. Swanton, Anthropological Society; J. N. Rose, Biological Society; T. H. Kearney, Botanical Society; F. B. Power, Chemical Society; W. D. Hunter, Entomological Society; O. H. Tittmann, Geographic Society; W. C. Mendenhall, Geological Society; P. S. Roy, Medical Society; A. C. Clark, Historical Society; A. Hrdlicka, Archeological Institute; R. Zon, Society of Foresters; E. F. Wendt, Society of Engineers; P. G. Agnew, Institute of Electrical Engineers.

Dr. Charles V. Norris, Chief of the Pathological Laboratories of Bellevue Hospital, has been appointed by Mayor Hylan to be chief medical examiner for New York City.

Dr. L. C. Glenn, of Vanderbilt University, has been made acting state geologist on the Tennessee Geological Survey until a successor to the late Dr. A. H. Purdue can be secured. Dr. J. I. D. Hinds, of Lebanon, has been appointed chemist of the Tennessee survey. A short time before the death of Dr. Purdue, he asked Dr. Hinds to take this position as successor of Dr. Paul C. Bowers, who had been called to Washington for government service, and he has been in charge of the state work since December 10.

Major Grayson M. P. Murphy, of New York, has resigned as head of the American Red Cross Commission to Europe. It is reported that he will return to service in the U. S. Army. Major James W. Perkins of New York, who has been serving with the

American Red Cross Commission in Europe since last June, will immediately take up the direction of the commission's work.

Dr. H. L. Russell, dean of the College of Agriculture of the University of Wisconsin, has been granted leave of absence by the university, at request of Mr. Herbert Hoover, U. S. Food Administrator. Dr. Russell will organize the Section of Agricultural Relations which will connect the work of the Food Administration and the U. S. Department of Agriculture along production lines and present the work of the administration to the extension agencies of the agricultural colleges.

The Food Adminstration has requested and secured from the New York Agricultural Experiment Station, leave of absence for F. H. Hall, vice director and editor of that institution, in order that he may take charge of the publicity work of the Food Administration dealing with perishable foods.

The following members of the faculties of Harvard University have been granted leave of absence: Albert Sauveur, professor of metallurgy and metallography, who is to continue his research work for the French government; Reginald A. Daly, Sturgis-Hooper professor of geology, who is to take up Y. M. C. A. work; Julian L. Coolidge, assistant professor of mathematics, who has been commissioned a major in the Ordnance Department; Lester R. Ford, instructor in actuarial mathematics, who is to enter the military service; Samuel W. Ellsworth, assistant in roentgenology, who has been commissioned captain in the Medical Reserve Corps.

Charles A. Kofoid, professor of zoology, University of California, has been appointed major in the Sanitary Corps of the U. S. Army.

Dr. George A. Soper, consulting sanitary engineer in New York City, has been appointed major in the Sanitary Corps of the National Army.

Dr. Walter R. Parker has been granted leave of absence from the professorship of ophthalmology in the medical school of the University of Michigan, to accept service as major in the Medical Reserve Corps.

Associate Professor J. C. Riley, of the department of mechanical engineering of the Massachusetts Institute of Technology, has been given the commission of major in the Signal Corps.

Professor Sterling Temple, of the department of chemistry of the University of Minnesota, has gone to Washington where he is to engage in work as a civilian in the ordnance department.

Leave of absence has been granted to Professor David L. Webster, of the department of physics of the University of Michigan, to enable him to accept a first lieutenancy to do research work on aviation instruments.

Leave of absence has been granted to Lewis Knudson, professor of botany in the college of agriculture of Cornell University, till next September, to permit him to engage in Y. M. C. A. war work in France.

Dr. William S. Thayer, of the Johns Hopkins Medical School, has returned to the United States after four months in Russia, as a member of the mission sent by the American Red Cross.

Dr. H. Gideon Wells, of the University of Chicago, has returned from Roumania to which country he was sent as a member of the American Red Cross Mission.

Professor E. V. McCollum, head of the department of chemistry of the school of hygiene and public health of the Johns Hopkins University, will deliver the Packard lecture before the American Pediatric and Rush societies of Philadelphia on February 12. The subject of the lecture is "Growth."

A Harvey Society lecture will be delivered at the New York Academy of Medicine on February 9 by Professor John Gordon Wilson, of Chicago. The subject is "The effect of high explosives on the ear."

Dr. Frank R. Van Horn, professor of geology and mineralogy at the Case School of Applied Science, in Cleveland, lectured on January 22, on "Some geological features of

Alaska and the Yukon" before the faculty and students of Purdue University.

At the annual meeting of the Royal Microscopical Society Mr. E. Heron-Allen delivered his presidential address on the society during the great war and after.

A course of public lectures on some biological problems of to-day is being given at University College, London, during January and February as follows: On the problem of food, by Professor W. M. Bayliss, F.R.S., on January 21; on war bread and its constituents, by Professor F. G. Hopkins, F.R.S., on January 28; on accessory food factors (vitamines) in war diets, by Miss E. Margaret Hume, of the Lister Institute, on February 4; and on alcoholic and other beverages, by Professor Cushny, on February 11.

The lecture arrangements of the Royal College of Surgeons of England for February are as follows: February 6, on the surgical treatment of neuralgia, by Mr. Jonathan Hutchinson; February 8, on the treatment of war injuries of the jaw and face, by Mr. Percival P. Cole; February 11, on the diagnosis and treatment of syphilis of the central nervous system, by Dr. Hildred Carlill; February 13 and 15, on the Quaderni d'Anatomia by Leonardo da Vinci, by Professor William Wright; February 18, on the structure of the English skull, by Mr. F. G. Parsons; February 20 and 22, on projectile fracture of limb bones, by Mr. E. K. Martin, and February 25, on the pathological aspect of certain war injuries of the eye, by Colonel W. T. Lister, C.M.G.

On February 28, 1918, The American Museum of Natural History in cooperation with the delegates from the New York Academy of Sciences, Section E of the American Association for the Advancement of Science and the New York Mineralogical Club, will hold a memorial meeting at The American Museum of Natural History in honor of Abbé René Justus Hauy, 1743–1822, the great French crystallographer. Papers are expected from Edgar T. Wherry, Edward H. Kraus, George F. Kunz and others, and one written for the celebration by the late L. P. Gratacap will be read. Portraits of Abbé Hauy and the Hauy Frères, as well as mineralogical books of the eighteenth and nineteenth centuries will be shown. Dr. George F. Kunz, 405 Fifth Avenue, New York City, is chairman, and Dr. Herbert P. Whitlock, the New York State Museum, Albany, N. Y., is secretary of the committee of arrangements.

The following resolution on the death of Dr. Theodore Janeway, has been adopted by the General Medical Board of the Council of National Defense:

> The general medical board of the advisory commission of the Council of National Defense desires to place on record its profound sense of loss in the death of one of its most active and useful members, Dr. Theodore Janeway, professor of medicine in the Johns Hopkins University, of Baltimore. In this loss it shares with the entire medical profession, from which has been taken one of its chief ornaments. Dr. Janeway has rendered conspicuous service to the country by his devoted and successful efforts in the Surgeon General's office in aiding in the selection of the medical personnel of the Army hospitals. He has died as truly in the service of his country as if on the field of battle.

On Tuesday evening, January 29, a seminary in Stimson Hall, Cornell University, was devoted to an appreciation of Dr. F. P. Mall, for his work in advancing anatomical science, and for the training and encouragement he gave to young men and women who are in the medical and teaching professions.

Rollin A. Harris, since 1890 mathematician to the U. S. Coast and Geodetic Survey, died suddenly on January 17, aged fifty-four years.

Professor Charlotte Fitch Roberts, Ph.D., since 1894 head of the department of chemistry at Wellesley College, died in her fifty-eighth year, after a very brief illness, on December 5, 1917. A correspondent writes: "Through earnest and effective teaching she has, through her contact with a very large number of pupils, rendered a real service to chemistry. The loss of her genial companionship is keenly felt by a large circle of friends."

Dr. W. L. Purves, a distinguished English aural surgeon, has died at the age of seventy-five years.

Plans have been perfected and the contracts let for converting the Billings estate on Washington Heights, New York City, into a war hospital. This property, comprising fifty-seven acres of land, was purchased about a year ago by John D. Rockefeller, Jr., with the idea of eventually giving it to the city for a park. The plans for the war hospital call for the expenditure of $500,000 for remodeling the buildings already on the property and the erection of additional buildings necessary to the completion of a hospital system.

The new museum of Santa Fe, New Mexico, according to the *American Museum Journal*, has been dedicated with ceremonies extending from November 24 to 28. The building is patterned after the old Mission Church on the Rock of Acoma, in a style of architecture said to be one hundred and fifty years older than the California missions. A feature of the dedication was an exhibition of paintings by well-known members of the Santa Fé and Taos artist groups, including Robert Henri, E. J. Couse, J. H. Sharp, Walter Ufer and others, on subjects inspired by Indian, Spanish and frontier lore, and consisted of addresses, concerts, Indian dances and excursions to Indian pueblos and ancient cliff dwellings. The American Museum was represented by Dr. Clark Wissler, curator of the department of anthropology, who gave an address on "The Opportunities of the New Museum," and by Mr. N. C. Nelson, who spoke on "Recent Archeological Discoveries in the Southwest."

UNIVERSITY AND EDUCATIONAL NEWS

Five members of the present University of North Carolina faculty have been appointed by the trustees Kenan professors, under the provision in the bequest of Mrs. Robert W. Bingham (Mary Lily Kenan) made public last August. They were chosen by vote of the faculty because of distinguished service rendered in the field of scholarship and university affairs. They are Professor Francis P. Venable, of the department of chemistry; Professor H. V. P. Wilson, of the department of zoology; Professor Edwin Greenlaw, of the English department; Professor William Cain, of the mathematics department, and Professor W. deB. MacNider, of the school of medicine. The Bingham bequest was made for the purpose of strengthening the faculty of the university, an annual sum of $75,000 being proided for the purpose of augmenting aid received from the state.

Columbia University plans a large diagnostic clinic for the people who do not wish to accept charity and who are unable to pay for the services of a number of experts whose special advice or examinations may be needed in order to make a diagnosis. The financial arrangement provides that every clinical worker will be paid for his work and every patient charged a fee commensurate with his income.

The University of Maryland, by a recent ruling of the faculty, beginning the next October term, will accept women students in the medical department. This ruling admits women to every department of the university, as they have been accepted in the dental, pharmacy and law departments for some time.

As Padua has recently been the objective of Austrian air raiders, the rectorate and academic council of the university have been by official decree transferred temporarily to Pisa. The same decree authorized the minister of education to allow professors of Padua to lecture in other universities and superior institutions.

At the Massachusetts Institute of Technology William F. Jones has been appointed instructor in geology, Royal E. Grant, instructor in physics, C. H. G. Gray, assistant in electrical engineering and Dr. F. H. Thorp, lecturer in industrial chemistry.

DISCUSSION AND CORRESPONDENCE

CYCADEOID WOOD STRUCTURE

In a recent communication in the *Annals of Botany* describing certain Cycadeoid rootlets Dr. Marie C. Stopes remarked the presence of scalariform structures. These are in agreement, of course, with the main body of secondary wood, which in the Cycadeoids is uni-

formly scalariform instead of pitted as in the Cycads. Dr. Stopes then takes issue with the opinion expressed in the well-known text-book of Scott to the effect that [in Cycadeoids]

> the histological details of both wood and bast agree precisely with the corresponding structures in a recent cycad.

It is even stated that no plants agree with the Cycadeoids. In the case of long-known structures represented by such profuse material as the groups referred to, botanists should be able to agree more closely as to the facts.

The point involved is that while these groups agree in their general structures and present many points of histologic contact, neither is without singularities of its own. Chamberlain makes essentially the same statement as Dr. Scott. And I see no final reason for disagreement. The old cryptogamic wood is in the Cycads as completely lost as in the later Cordaiteans, but next the pith both the existing and fossil Cycads are in very essential agreement; and in both the passage from scalariform to pitted wood is the same. Perhaps the two groups might be considered divergent histologically were it not for the fact that *Stangeria* like the Cycadeoids is an essentially scalariform type and thus forms a connecting link on the one hand; while on the other, *Cycadeoidea micromyela* has pitted wood near the cambium layer.

The differences observed are therefore not so great as they at first sight appear. And such differences are found moreover in existing dicotyls. Thus in *Trochodendron,* which has pronounced growth rings, the spring wood presents the same scalariform type as the wood of the Cycadeoids; while in the related *Drimys* with rather suppressed growth rings the main body of wood is as strikingly pitted as in Cycads or *Araucaria.* The explanation is obvious when the seedling of *Drimys* is studied. There is the same transition from the scalariform to the pitted wood as in the existing and fossil Cycads. It may be remarked incidentally that were the stems of *Trochodendron* and *Drimys,* as well as other Magnoliaceæ, divested of their radial storage tissue the agreement with both the Cycads and Cycadeoids would be a striking one indeed. It is easy, however, to look upon this storage tissue as a comparatively modern structure. There is a definite suggestion that medullar reduction and profuse branching are in some way correlated with the development of thick-walled storage tissue by dicotyls. It is not necessary to enter further upon this topic at this time; but it is evident that the facts fully sustain Scott's simple form of statement as to the agreement histologically of the Cycad and Cycadeoid woods as based partly on the study of Solms and myself.

G. R. WIELAND

YALE UNIVERSITY

THE RELATION BETWEEN AGE AND AREA IN THE DISTRIBUTION OF PLANTS

IN a discussion of the "Age and Area" hypothesis of Professor Willis, by E. W. Sinnott, in SCIENCE for November 9, 1917, the author very justly sets out with the contention that "other factors than age share in the area occupied by a species." Factors inherent in the plant itself, he tells us, such as hardiness, adaptability, growth habit and the like, play a very important part in determining distribution.

As a notable illustration in support of this statement, I would call attention to the rapid dispersion of a comparatively recent immigrant, the Japan honeysuckle (*Lonicera Japonica*) which now occupies a wider area in our southeastern states than the longleaf pine, and others of our "oldest inhabitants." My first recollection of this plant goes back to that now almost prehistoric time, vaguely recorded in the popular mind as "before the (civil) war," when it was known only as a garden plant. It continued in favor as an ornamental vine for piazzas and pergolas for a decade or so later, until it began to "run wild" at such a rate that it fell into disrepute for ornamental purposes, and is now the most aggressive and indomitable enemy with which our native plant population has to contend. Unlike the common herbaceous weeds of cultivation, it does not confine itself to roadsides and waste places, but invades the most secluded haunts of the wild flowers, strangling

or smothering under its rank foliage every green thing that stands in its way. It is no uncommon thing to see whole acres of haw thickets and other shrubby growth enveloped in its deadly meshes, and destined to slow extermination by this ruthless invader. Among its victims I have seen a remarkably fine specimen of "tree haw" (*Cratægus viridis*) 4 dm. in diameter, 12 m., more or less, in height, and about the same in spread of crown, reduced to little more than a mere leafless skeleton under the throttling grasp of its oppressor. So closely was it enveloped in the meshes of the woody twiner, that I had to cut my way through them with a hatchet in order to take the measurements given above.

While it prefers a rich, moist soil, as most plants do when they have the choice, this aggressive intruder can accommodate itself to almost any conditions, trailing like an humble creeper along the barren slopes of arid hillsides, rambling over wire fences along the borders of dusty roads, from the cool slopes on the plateau of Lookout Mountain, to the deepest ravines in the valley, and onward, over the granite hills of the Piedmont region, it has made itself at home. I could supplement this case with some equally striking instances of the rapid distribution of herbaceous plants, but it seems to me that the example of a shrubby species which, in spite of the fact that these are, in general, much less efficient travelers than herbs, has been able to naturalize itself, within the memory of people now living, over an area extending from the Gulf of Mexico to the estuary of the Hudson, and for a thousand miles up the great Appalachian Valley, may be taken as sufficient evidence that other factors than time influence the distribution of species over a given area.

E. F. Andrews

Rome, Ga.

ORIGIN AND DEVELOPMENT OF THE PHOTOGENIC ORGANS OF PHOTURIS PENSYLVANICA

There are at present three conflicting views regarding the origin of the photogenic organs in insects. One view is that they are modified hypodermal cells, another that they are formed from both ectoderm and mesoderm, and lastly, that they are mesodermal, being derived from fat cells. Of these three views that of the fat-cell origin has been the most generally accepted. Moreover, recently two important papers have appeared which apparently definitely settle the question in favor of the theory of fat cell origin. The first of these was by Vogel ('12), who worked on the embryology of *Lanopyris noctiluca*, the other by Williams ('16), based on a study of the embryology of our native species *Photuris pensylvanica*.

Unaware of Williams's work, I had undertaken, at the suggestion of Dr. W. A. Riley, a study of the embryonic development of the photogenic organs of *Photuris pensylvanica*.

During the summer of 1916, the eggs of this species required, on an average, 26 days to complete their development.

These eggs cut in sagittal sections 3 microns thick, showed in the fourteen-day embryos that the hypodermis on the ventrolateral portion of each side of the eighth abdominal segment, in its anterior region, was definitely thickened, due to proliferation and enlargement of its cells.

In the fifteen-day embryos the organ appeared as a distinct nodule which projected from the inner surface, though at this stage there was no evidence of any separation from the hypodermis. Further, it was found that there was no evidence of any relation between the fat cells and those of the nodule, in this, or the fourteen-day embryos.

In the sixteen- to seventeen-day embryos the organ is completely separated from the hypodermis, except at its two ends, where it remains attached. From Vogel and Williams's descriptions of the earliest condition of the light organ that they observed, one would be led to believe that it was the study of this stage of development, on which they based their conclusions regarding its origin. At this time the fat cells lie in rather close proximity to those of the light organ and somewhat resemble them.

In embryos nineteen to twenty days old, there occurs a differentiation of the cells of

the photogenic organ, by which the two layers are formed. About this time the tracheal and nerve connections become fully established. At the age of twenty-two days the organ begins to emit light.

In this connection it may be stated that my observations confirm Dahlgren's recent announcement that the adult organs in the pupa arise from the hypodermis.

Walter N. Hess

Cornell University

JOSEPH YOUNG BERGEN

To the Editor of Science: In my paper in memory of Joseph Young Bergen, which appeared in Science, January 4, 1918, I stated that he was the son of a clergyman. I am now informed by Mrs. Bergen that this statement is incorrect.

Edwin H. Hall

Cambridge, Mass.,
January 30, 1918

SCIENTIFIC BOOKS

The Casting-Counter and the Counting-Board. A Chapter in the History of Numismatics and Early Arithmetic. By Francis Pierrepont Barnard. Oxford. At the Clarendon Press. 1916. 357 pp. + LXIII. plates. Price £3 3s.

When we consider the rôle played by the abacus in the history of calculation, first as the primitive and probably prehistoric dust board and finally in the form of the elaborate reckoning machines of the present day, we can see that the history of mechanical computation is closely tied up with the history of the race. It is true that for long periods we have no reference to such a device as the abacus, but for equally long periods we have no reference to many of the common customs of life and to the everyday implements used in the home. It is probable that one would have to search long in the written records of the early periods to find any reference to such homely words as button or shoestring, or to such common actions as the combing of the hair, the milking of a cow or a goat, the cooking of a piece of beef, or the making of a sandal or a shoe, and yet all these words and actions have been commonplaces for thousands of years. The recording of the use of common devices is generally inversely proportional to the frequency of their use, and this is probably one reason why the abacus, in one form or another, is not more frequently mentioned in the chronicles of various peoples.

There were three standard forms of the abacus in ancient times, the dust board, which was the forerunner of the wax tablet as the latter was of the slate; the board on which counters or small disks were moved about, these counters appearing in Rome as pebbles or marbles (calculi); and the bead abacus, the counters running in grooves or on wires, a form still found in schools in our country and familiar as the Chinese *suanpan,* the Japanese *soroban,* and the Russian *tschotü* or the Armenian *choreb.*

Of these various forms, the most interesting for the general reader of the Western World is the board on which calculi were moved, since these counters are so often mentioned in our literature. Adelhard of Bath (c.1120) speaks of such a table, saying that "quidem mensam pithogoream ob magistri sui reuerentiam. sed postī tamē abacum dixerunt," having probably in mind a passage from Boethius: "Pythagorici vero . . . mensam Pythagoream nominabant . . . a posteribus apellabatur abacus." We find the name of *abacisti* given to those who were skilled in computation with the counters, and even the verb "to abacus" is occasionally found, as in a certain manuscript of the eleventh century—"Hoc si abacizando probaveris." In later times the references to counters become very numerous. So we have in English such expressions as "Sitte doun and take countures rounde," "A nest of cowntouris," "The kitchin clarke . . . jangling his counters," "A counter caster," "Any that can but cast with Counters," and "I shall reken it syxe tymes by aulgorisme or you can caste it ones by counters." From the use of the word as representing a disk we also find it employed to represent the person, as in the expression, "Ther is no countere nor clerke con hem recken alle," and also to repre-

sent the table, as in the expression "Thogh Argus (that is, al-Khowarizmi) the noble covnter Sete to rekene in hys counter." The story is connected with Fitz-Neal's "*Dialogus de Scaccario*" of 1178 and the court of the exchequer, with backgammon, and with divers other ramifications. The counter went by various names, such as Rechenpfennig, Zahlpfennig, and Raitpfennig in Germany; projectiles and abaculi as well as calculi in Latin; jetons, gectz, getoirs, giets, and the like in France; Leggelt and Werpgeld in Holland; and jettons and Venetian money as well as counters in England.

It is the field of counters that Professor Barnard has made his own in the monumental and sumptuous work under review. For many years he has been collecting specimens of counters of the various European countries. He has examined upwards of 40,000 specimens and has in his own cabinet some 7,000, most of those described being in this collection. With great care he has selected typical specimens, the choice being determined by their historical importance, artistic merit and general value. Fifty-nine Early English jettons are described, nineteen Italian, three hundred seventy-two French, ninety Low Country, one hundred twenty-two German, and four Portuguese. Each specimen is illustrated photographically and each is described with all the care of a trained numismatist. Nothing could be more satisfactory to the collector or the student, and it would be difficult to suggest a single particular in which the descriptive material could be improved.

To the historian of mathematics one of the items of greatest value is the set of photographs of reckoning tables at Basle and Nürnberg, of reckoning cloths at Munich, of illustrations from manuscripts and early printed books, and of Dutch jetton cylinders, together with a description of each. There is also a valuable list of one hundred fifty-nine extracts from English inventories with references to counting boards, thus showing that these devices were common from the fourteenth to the sixteenth century at least. The first two of these extracts, of date 1321 and 1337, respectively, make mention of "Camera quædam cum mensa quadrata ad calculandum" and of "Unum computatorium," while other interesting items refer to "the cheker," "counting-bord," "unum scaccarium," "cowntynge borde or table," "accomptyng borde," "unam mensam vocatam a counter," and "the counterborde in the Hall."

Perhaps the most important part of the work from the standpoint of the historian is that on "the methods of casting with jettons" (pages 254–319). Here Professor Barnard has given a very satisfactory summary of the more important European works on the subject, such as those by Recorde, Awdeley, Reisch, Cusanus, Siliceus, Köbel, de Moya, and Trenchant. There should also be mentioned as of great value to students the bibliography of upwards of six hundred titles.

Taken as a whole the work may be safely characterized in superlatives. Such an elaborate treatise on any special field of the history of mathematics has never before appeared, nor are we likely soon to see another. The infinite pains taken by the author in his research, the munificence shown in the publication itself, and the fact that a mass of technical material is presented in a style that makes every page readable, all combine to render the work unique in its way. No library of reference can afford to be without the book, and students of the history of mathematics should add it to their personal libraries as soon as they can arrange to do so. It will be the classic upon the subject for generations to come.

David Eugene Smith

The Nature of Solution. By Harry C. Jones. New York, D. Van Nostrand Co. 1917. 23 x 15 cm.; pp. xxiv + 380.

The present work is not a text-book, but a general discussion of some of the more important properties of solutions, true and colloidal. It is therefore written in a non-mathematical, indeed, largely in a semi-popular style. It is hoped that this work may interest students of the various branches of science to go on into the real physical

chemistry of solutions, and from this into physical chemistry in its broadest sense.

As far back as 1893 Jones did some work with Arrhenius on the hydrates of sulphuric acid. In 1900 he suggested that part of the abnormal changes of the freezing-point with concentrated solutions is due to the solute forming a compound or solvate with the solvent, so that the real concentration is or may be much greater than the apparent concentration. From this time on Jones devoted practically all his time to a study of solvates in solution. The results are remarkable in quantity and in range. Jones points out, p. 346, that "the following sixteen lines of evidence bearing on the solvate theory of solution have been established:

"1. Relation between lowering of the freezing-point of water and water of crystallization of the dissolved substance.

"2. Approximate composition of the hydrates formed by various substances in solution.

"3. Relation between the minima in the freezing-point curves and the minima in the boiling-point curves.

"4. Relation between water of crystallization and temperature of crystallization.

"5. Hydrate theory in aqueous solutions becomes the solvate theory in general.

"6. Temperature coefficients of conductivity and hydration.

"7. Relation between hydration of the ions and their volumes.

"8. Hydration of the ions and the velocities which they move.

"9. Dissociation as measured by the freezing-point method and by the conductivity method.

"10. Effect of one salt with hydrating power on the hydrates formed by a second salt in the same solution.

"11. Investigations in mixed solvents.

"12. Spectroscopic evidence bearing on the solvate theory of solution; work of Jones and Uhler.

"13. Work of Jones and Anderson on absorption spectra, in which the presence of 'solvate' bands was first detected. This showed that the solvate had an effect on the absorption of light, and this could be explained only as due to a combination between the solvent and the resonator, or something containing the resonator.

"14. The work of Jones and Strong on absorption spectra established the existence of a large number of 'solvent' bands. They showed that these were formed by many salts and in many solvents. They could even distinguish between the bands of a salt in a given alcohol and in its isomer. This was regarded as very important. The temperature work of Jones and Strong was strong evidence for the solvate theory.

"15. The work of Jones and Guy on the effect of high temperature on the absorption spectra of aqueous solutions, and also on the effect of dilution, led to results which were also in keeping with the solvate theory. The most important work of Jones and Guy which bears on the solvate theory of solution is that in which the radiomicrometer was used. It was here shown that solutions of certain strongly hydrated non-absorbing salts are more transparent than pure water having a depth equal to that of the water in the solution. In the case of non-hydrated salts the solution was the more opaque. This shows that water in combination with the dissolved substance—water of hydration—has less absorption than pure water. This is regarded as striking evidence that some of the water in the presence of salts which are shown by other methods to hydrate is different from pure, free, uncombined water; and the simplest explanation seems to be that this is the combined water or water of hydration.

"16. The work of Jones and Guy was repeated and extended by Jones, Shaeffer and Pauls. They obtained results of the same general character as those

> found by Jones and Guy. Solutions of hydrated salts were in general more transparent than pure water, especially at the centers of the absorption bands. Solutions of non-hydrated or only slightly hydrated salts are more opaque than pure water, especially at the centers of the bands."

The quantitative conclusions are based on the two assumptions that the van't Hoff formula holds absolutely when the true concentrations are used, and that the percentage dissociation can be calculated from the conductivity. Unfortunately, neither of these assumptions is true. There are many who think very highly of Jones' work and there are those who are more critical. All will agree, however, with the words of Professor Reid in the biographical sketch, that Jones was an advocate rather than a judge. WILDER D. BANCROFT

SPECIAL ARTICLES

COMPARATIVE PERMEABILITY OF FERTILIZED AND UNFERTILIZED EGGS TO WATER

IN general the rate of the osmotic entrance or exit of water, in any living cell, after transfer from its normal medium to another non-injurious medium (*i. e.*, one not impairing semi-permeability) of lower or higher osmotic pressure, varies directly (1) with the gradient of osmotic pressure between the interior and the exterior of the cell, (2) with the area of the semi-permeable membrane enclosing the cell, and (3) with the permeability of this membrane to water. It is to be expected that this permeability to water will vary in different physiological states of the cell; and that the same species of cell, placed in the same medium, will show variations in the rate of the osmotic transfer of water, *i. e.*, in its rate of swelling or shrinkage, according to its physiological condition or state of functional activity at the time of the transfer. There is in fact a definite and constant difference between the fertilized and the unfertilized eggs of the sea-urchin *Arbacia* in this respect, fertilization being followed regularly by a marked increase in the permeability of the egg-surface to water—as may readily be shown by bringing the eggs into either dilute or concentrated sea-water; in the former medium they swell, in the latter they shrink, but in both cases the rate of the process is much greater in the fertilized than in the unfertilized eggs. In the unfertilized eggs both swelling and shrinkage are surprisingly slow, so that in a medium whose osmotic pressure differs from the normal by so much as ten or twelve atmospheres these eggs show little apparent alteration of size at a time (*e. g.*, two minutes after placing in this medium) when the fertilized eggs are conspicuously swollen or shrunken. This difference of behavior relates entirely to the *rate* at which water either enters or leaves the egg; the *degree* of swelling or shrinkage when osmotic equilibrium is reached is approximately the same in both cases. It is clear therefore that this difference has nothing to do with any possible change in the osmotic pressure of the egg-protoplasm, resulting from fertilization, but is determined simply by the greater readiness with which water enters or leaves the fertilized as compared with the unfertilized egg. According to former measurements made on the rate of swelling of fertilized and unfertilized eggs in dilute sea-water, the resistance to the passage of water across the plasma-membrane is decreased approximately four times as a result of fertilization.[1]

The most striking and convenient method of showing this difference is to place a mixture of equal numbers of unfertilized and fertilized uncleaved eggs (the latter fertilized at least 15 minutes previously) in a somewhat strongly hypertonic sea-water (*e. g.*, 1 volume of van't Hoff's artificial sea-water of 2.5 m concentration *plus* 4 volumes normal sea-water). The fertilized eggs at once shrink rapidly and undergo crenation, and within less than one minute exhibit a collapsed, shrunken, and angular appearance; at this time the unfertilized eggs show little change, so that a striking contrast is presented. Shrinkage continues slowly in the unfertilized eggs, and becomes well marked in the course of five or six minutes, but a curious

[1] *Amer. Jour. Physiol.*, 1916, Vol. 40, p. 249.

difference is that the eggs remain smooth and spherical during the entire period of shrinkage, the surface showing none of the folds and crenations so characteristic of the fertilized eggs. Evidently the properties of the plasma-membrane have undergone profound changes during fertilization, so that by the above simple osmotic method the fertilized eggs are immediately and sharply differentiated from the unfertilized. One incidental effect of the rapid shrinkage of fertilized eggs (which involves a corresponding increase in density) is that they sink at first in the hypertonic sea-water more rapidly than unfertilized eggs; and in fact a partial separation of the two kinds can readily be accomplished in a test-tube or graduate by taking advantage of this difference in the rate of sinking.

Shrinkage, if not too pronounced, has little or no injurious effect upon the eggs, and fertilized eggs after return to sea-water continue their development. The osmotic properties of the plasma-membranes are apparently unaffected by the process of shrinkage. If mixed eggs that have been well shrunken by exposure to the above hypertonic sea-water for five minutes are returned to normal sea-water, it is observed that the fertilized eggs regain their normal water-content much more rapidly than the unfertilized; after a minute in the normal sea-water they are distinctly the larger of the two. Later, as the unfertilized eggs also approach osmotic equilibrium this difference disappears.

Experiments similar to the above were also performed with the fertilized and unfertilized eggs of the sand-dollar, *Echinarachnius parma*. These eggs were found similar to those of *Arbacia* in their behavior in dilute and concentrated sea-water.

Artificial membrane-formation by treatment with butyric acid produces the same kind of change as normal fertilization in the osmotic properties of *Arbacia* eggs, but the degree of the effect is much more variable. It was interesting to find that the rate of shrinkage in hypertonic sea-water shows a definite correlation with the character of the membrane separated from the egg; when this is well separated and sharply defined in appearance the rate of shrinkage, the crenation, and the other features of the behavior approach closely those of sperm-fertilized eggs; on the other hand, eggs with poorly formed membranes show more gradual shrinkage and relatively little crenation; while eggs which show little or no indication of membrane-formation (some of which are always present) show the slow shrinkage and lack of crenation characteristic of unfertilized eggs. Such gradations of behavior, indicating gradations in the degree to which permeability has been increased by the treatment, are always found. This variability is probably correlated with the variability in the developmental capacity of artificially activated *Arbacia* eggs, which typically yield only a small proportion of normal larvæ.

The above change in the properties of the plasma-membrane does not take place suddenly, but begins gradually and requires about 20 minutes after fertilization (at 20°–22°) to reach an approximate final stage. The change is thus progressive and continues long after the separation of the fertilization-membrane. At five or six minutes after insemination there is little apparent difference from unfertilized eggs, *i. e.*, the eggs shrink slowly in hypertonic sea-water and do not crenate; at nine or ten minutes shrinkage is considerably more rapid and there is some crenation; at thirteen to fourteen minutes the majority show well-marked crenation within one minute; at twenty minutes both rate of shrinkage and degree of crenation are still further increased, although the maximum is not reached until considerably later. It is evident that some special process is initiated by the spermatozoon, having the effect of changing the properties of the plasma-membrane in the direction of increased permeability to water and increased liability to crenation.

The intimate nature of this process can not be defined clearly at present, but it was found to be checked or arrested, reversibly, by anesthetics or high concentrations of cyanide.

Eggs placed within two or three minutes after insemination in sea-water containing the following anesthetics were found to retain the condition of low water-permeability (the state characteristic of unfertilized eggs) during the period of exposure to the anesthetic, *e. g.*, 30 minutes or more; if they were then brought back into normal sea-water the permeability underwent the usual increase and development continued. Chloral hydrate, chloroform, alcohols (methyl, ethyl, propyl, isobutyl, i-amyl). ethyl urethane, ether, all show this effect in appropriate concentrations, which are approximately the same as those required for anesthetizing the cleavage-process. It is clear therefore that the permeability-increasing phase of the activation-process, after it has once started, may be temporarily inhibited by anesthetization. Potassium cyanide has a similar effect, but only in relatively high concentrations (above $n/200$, with some slight effect at $n/400$); in lower concentrations, *e. g.*, $n/1,000$ (which is many times greater than that required to arrest cleavage completely), no evident effect was observed. It is probable that the anesthetics inhibit the permeability-increasing process by a different kind of influence from that exerted by cyanide.

RALPH S. LILLIE
CLARK UNIVERSITY,
WORCESTER, MASS.

THE AMERICAN SOCIETY OF NATURALISTS

THE thirty-fifth annual meeting of the American Society of Naturalists was held in the Carnegie Museum, Pittsburgh, January 1, 1918. In affiliation with the society this year were Section F of the American Association for the Advancement of Science and the Botanical Society of America.

The report of the treasurer, stating a balance on hand of $657.11, was accepted.

The following changes in the constitution, recommended by the executive committee, were authorized.

Article II., Section 1, the following sentence to be added: A nomination for membership in the society shall remain in the hands of the executive committee for at least one year before action is taken upon it.

By-law 2 to read: Each president on retiring shall appoint a committee of five to nominate officers and this committee shall present names for action by the society at its next annual meeting.

The following new by-law to be added: A publication committee, consisting of the three past-presidents, the secretary and the treasurer may select and arrange for the publication of papers presented before the society, provided that the society thereby is not involved in financial obligations.

It was recommended by the executive committee that the American Society of Naturalists cooperate with other biological organizations by electing two botanical members to serve on the committee on botanical abstracts, and that these members shall be nominated by the executive committee. This recommendation was adopted by the Society and the following were elected to represent the American Society of Naturalists on the committee on botanical abstracts: J. Arthur Harris (1919-20), Edward M. East (1919-22).

A resolution, as follows, framed by a committee consisting of Albert J. Blakeslee and Leon J. Cole, was adopted, and the secretary was instructed to forward a copy of it to the National Research Council.

Realizing the importance of placing all men who enter the national service where their training and abilities may be utilized to the maximum in the prosecution of the war, and in view of the experience of our allies, who at first failed to take advantage of the technical fitness of recruits for special war activities both at home and at the front and who later found it necessary to make readjustments at great loss of time and energy—be it

Resolved, That the American Society of Naturalists urge upon the National Research Council the desirability of taking such steps as may be necessary to secure the detailing to special scientific duty of men with technical training and ability who may have been called to military service, but who are found essential to scientific activities of the war.

There were elected to membership: Ethan A. Andrews, Johns Hopkins University; Ernest B. Babcock, University of California; Frank S. Collins, North Eastham, Mass.; Thomas H. Goodspeed, University of California; William H. Gregory, American Museum of Natural History; Heman L. Ibsen, University of Wisconsin; Karl F. Kellerman, U. S. Department of Agriculture; Vernon L. Kellogg, Stanford University; Richard S. Lull, Yale University; Robert K. Nabours, Kan-

sas Agricultural College; Charles D. Walcott, Smithsonian Institution; Charles Zeleny, University of Illinois.

On Saturday evening members of the Naturalists and of the affiliated societies attended a smoker given by the biologists of Pittsburgh at Carnegie Music Hall.

A symposium was presented in the afternoon session on the subject, *Factors of organic evolution.*

Climatic change as a factor in organic evolution, by ELLSWORTH HUNTINGTON. (Read by title.)

Migration as a factor in organic evolution, by C. C. ADAMS.

Method of reproduction as a factor in organic evolution, by E. M. EAST. (Read by title.)

Mutation as a factor in organic evolution, by T. H. MORGAN.

Mendelian inheritance as a factor in organic evolution, by C. B. DAVENPORT.

Natural selection as a factor in organic evolution, by J. ARTHUR HARRIS.

Disease as a factor in organic evolution, by THEOBALD SMITH. (Read by title.)

Intelligence as a factor in organic evolution, by R. M. YERKES. (Read by title.)

In addition to the symposium the following papers appeared upon the program:

Sex intergrades in Cladocera and their significance, by A. M. BANTA.

A demonstration of the origin of two pairs of female twins from two eggs of high storage metabolism, by OSCAR RIDDLE.

Changing the sex ratio in the rat through inbreeding, with selection, by HELEN D. KING. (Read by title.)

Changes in sexuality in plants, by A. B. STOUT.

Mutations in Datura, by A. F. BLAKESLEE.

Nutritional effects influencing the development of maize hybrids, by D. F. JONES. (Read by title.)

The inheritance of variations in the marginal spines of Silvanus surinamensis, by MARIAN E. HUBBARD. (Read by title.)

Parthenogenesis and inheritance in the grouse locust, Appotettix sp.?, by R. K. NABOURS.

The rôle of approaching extinction in evolution, by L. E. GRIFFIN.

Ticking, banding and silvering factors in cats in relation to the problem of mimicry, by P. W. WHITING.

Variations in somatic chromosome numbers, by R. T. HANCE.

Eleven matings in a species with heteromorphic tetrads; recombinations expected in the F_1, by E. ELEANOR CAROTHERS. (Read by title.)

Sex-determination in a parasitic wasp, Hadrobracon brevicornis Wes., by P. W. WHITING. (Read by title.)

The influence of sex on the color pattern of guinea-pigs, by SEWALL WRIGHT.

Atrophic fetuses in yellow mice and zygotic elimination, by J. A. DETLEFSEN. (Read by title.)

Fluctuations of sampling in a Mendelian population in mice, by J. A. DETLEFSEN. (Read by title.)

On the hybridity of Entylia sinuata Fab. and its forms occurring in nature, by S. I. KORNHAUSER. (Read by title.)

The independence of the germplasm and soma in Thelia bimaculata Fab., by S. I. KORNHAUSER.

The distribution of granular pigment in the hair of guinea-pigs, by H. R. HUNT and SEWALL WRIGHT.

Histological studies on trimerous bean seedlings, by J. ARTHUR HARRIS and J. Y. PENNYPACKER. (Read by title.)

The rôle of factor mutations in evolution, by E. B. BABCOCK. (Read by title.)

The result of cousin marriages through N generations, by F. A. SPRAGG.

Germinal changes in the bar-eyed race of Drosophila during the course of selection for facet number, by CHARLES ZELENEY.

The genetic and somatic relationship between vestigal and miniature wings in Drosophila ameлophila, by ORREN LLOYD-JONES and F. S. HULTZ.

The Naturalists' dinner was held on the evening of January 1 at the Hotel Schenley with fifty in attendance. The address of the president, Dr. George H. Shull, was entitled "The genotype and its environment."

The officers of the society for 1918 are:

President—William E. Castle, Harvard University.

Vice-president—Guy N. Collins, United States Department of Agriculture.

Secretary—Bradley M. Davis, University of Pennsylvania (1917–19).

Treasurer—J. Arthur Harris, Carnegie Station for Experimental Evolution (1918–20).

Additional members of the executive committee—Leon J. Cole, University of Wisconsin (1918); Frank R. Lillie, University of Chicago (1916–18); Raymond Pearl, Maine Agricultural Experiment Station (1917–19); George H. Shull, Princeton University (1918–20). BRADLEY M. DAVIS,

Secretary for 1917

SCIENCE

Friday, February 15, 1918.

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME UNDERLYING PRINCIPLES IN THE STRUCTURE OF THE NERVOUS SYSTEM[1]

It has long been recognized that the fundamental problems of the nervous system are impossible of approach without keeping in view continually the finer structure of the parts concerned. Nervous organs are not relatively homogeneous bodies as, for instance, glands are, but are intricate systems of conducting paths and end-stations and in this respect are unlike the other organs of the body. This contrast appears clearly in many deficiency tests. If a portion of a gland, such as the pancreas or the liver, is removed, the loss may be quickly covered by the increased activity of that part of the organ which is left, but the ablation of even a small portion of a nervous organ is often followed by serious and permanent defects, which no amount of activity on the part of the adjacent tissue can make good. Thus the destruction of a small group of the receptive cells in the retina results in a scotoma, which the activity of the adjacent cells is incapable of remedying. Hence it appears that in the nervous system specialization may be said to have reached even to the cells themselves. Such a degree of differentiation is to be found in no other organ of the body, except perhaps the reproductive glands, whose sperm cells and egg cells, with their highly individualizing capacities, are separately quite as unique as are many nerve cells. It is, therefore, not sur-

[1] Address of the vice-president and chairman of Section F, American Association for the Advancement of Science, Pittsburgh, December 31, 1917.

prising that neurologists have devoted much of their energy and time to discovering the disposition and arrangements of the cells in nervous organs.

Notwithstanding the fact that the cell doctrine as applied to animals was enunciated by Schwann as early as 1839, it was not till more than half a century later that a clear and consistent idea of the nerve cell was arrived at. The slowness with which this result was attained was due to the unusual form and complicated structure of this element. Nerve fibers, according to Stieda (1899), were probably first really seen and figured by the Florentine physician Felix Fontana in 1781, but it was not till 1833 that Ehrenberg in the preliminary announcement of a monumental work on the fibrous structure of the central nervous organs, described certain corpuscles that proved to be what later investigators called ganglion cells. The connection of these two elements, vaguely intimated in 1838 by Remak and surmised in 1840 by Hannover, was first really demonstrated for invertebrates in 1842 by Helmholtz and for vertebrates in 1844 by Kölliker who showed that fibers with a medullary sheath, and therefore unquestionably nervous, were directly connected with ganglion cells. From the time of these discoveries it became necessary to assume that in some way or other ganglion cells were an essential element in the nervous system. Their association with ganglionic masses and other deeper organs led naturally to the view that they were the real centers of nervous activity, the fibers being regarded as elements of conduction merely. Hence arose that infinite collection of diagrams of nervous mechanism devised by the neurologists and copied by the physiologists and psychologists of some two generations ago and consisting usually of an afferent fiber leading from the periphery to a centrally situated ganglion cell from which in turn an efferent fiber stretched out to a muscle or other like end-organ.

But the nervous system is not constructed upon so simple a plan. In 1847 Wagner showed that the ganglion cells in the electric lobes of the torpedo exhibited two types of processes. These were subsequently designated as protoplasmic and nerve-fiber processes by Deiters (1865), who attempted to support the generalization that every ganglion cell possessed both types of processes.

Not only did complications grow in these directions, but in 1855 Leydig discovered in the ganglionic bodies of spiders what appeared to be a finely granular material which he called punctate substance. Similar material was also shown to be a considerable constituent in the gray matter of the vertebrate nervous system. Hence, in addition to nerve fibers and ganglion cells, a third kind of material was shown to be present in many nervous organs.

This material, as was subsequently demonstrated by Gerlach (1871) and others, consisted in reality of very fine fibrils which when seen in section appeared as minute points; hence Leydig's name for it of punctate substance. From these very fine fibrils nerve fibers were seen to take their origin and thus arose the dispute over the direct and the indirect origin of nerve fibers, that is, their origin directly from ganglion cells or indirectly from these cells through the intervening fibrillar substance.

The confusion to which this discussion led was cleared up and swept away by the introduction of the Golgi method of silver impregnation, a method that yielded preparations so marvelously clear and sharp that for the first time the relations of nerve fibers, ganglion cells, and fibrillar material seemed within grasp. Although this method was described as early as 1873, it

did not come into general use till nearly a decade and a half later. Nevertheless, as soon as it was generally applied, it yielded such important results that in May, 1891, Kölliker could substantiate the claim that every nerve fiber in the body was at some part of its course directly connected with a ganglion cell, and in June of the same year Waldeyer, on the basis of conclusions drawn largely from Golgi preparations, promulgated the theory of the neurone, the first consistent account of the nerve cell.

According to this well-known doctrine the ganglion cell of the older workers is really the nucleated body of the true nerve cell, or neurone, whose processes may be of two kinds: short, branching, protoplasmic extensions, the dendrites; and long, unbranched, nerve-fiber processes, the neurites. As all nerve fibers were believed to be thus related to nerve cells they were at once classed as a special type of cell process. Further, the fibrillar material of the central gray, the punctate substance, which was regarded by Gerlach (1871) as a continuous network, was now looked upon as the ultimate branches of the dendrites and neurites, the means by which one neurone is put into communication with another. Hence this material was believed to be broken up into appropriate neuronic systems separated one from another by an infinitude of minute interruptions, which, however, were capable of physiological continuity through what is known as a synapse. Thus each neurone, or true nerve cell, was believed to possess a certain amount of independence from its neighbors though physiologically united to them at least by transmitting contact. This in brief is the conception of the neurone, or true nerve cell, a conception that has been most prolific in its consequences not only as a means of understanding the structural relations of nervous elements but of interpreting their degeneration as originally outlined by Waller (1850), their regeneration as worked out by subsequent investigators, and their development as first clearly described by His (1886).

This conception, however, was not based on what can be seen in Golgi preparations only; it was confirmed and supported by a great array of results such as have been obtained by Ehrlich's methylen-blue treatment and by the host of new metal-impregnation methods modelled more or less on the original Golgi procedure.

In considering the activity of the typical vertebrate neurone, it is generally recognized that the nerve impulse enters this element through its dendrites and, after traversing its cell body, emerges from it through its neurite. This is very clearly seen in the motor neurones of the spinal and the cranial nerves (Fig. 1). Here the

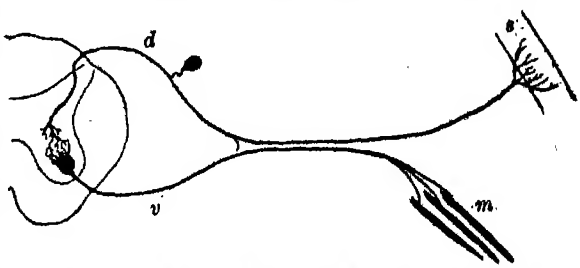


FIG. 1. Diagram of the primary neurones of the spinal cord; the dorsal neurone (d) extends from the skin (s) to the central gray of the cord, the ventral neurone (v) from the central gray to the muscles (m).

dendrites of the given neurone are in close relation with the neurite processes of other neurones (d) from which they receive nerve impulses that are passed on through their own cell body and over its neurite to be discharged finally into the attached muscle fibers (m). As in such series the dendrites serve as a receptive mechanism and the neurite as a discharging one, it may be claimed that the neurone exhibits a kind of cellular polarity in which the dendrites

mark one pole and the neurite the other. This idea of the polarity of the neurone seems to have originated with van Gehuchten (1891), but on its announcement it was immediately taken up, amplified and strongly advocated by many other neurologists, especially by Ramón-y-Cajal (1891) and by Retzius (1892). Even now it holds a place in good text-books such as Herrick's Introduction to Neurology (1915), but it has never been without its serious opponents.

Barker (1899) in his account of the nervous system pointed out numerous and serious exceptions to it. The intermediate neurones of the vertebrate retina (Fig. 2, *i*)

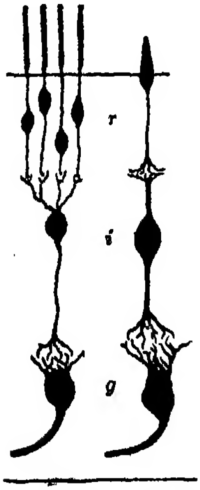


FIG. 2. Diagram of the chief nervous elements in the vertebrate retina; rod- and cone-cells (*r*), intermediate cells (*i*), and ganglion cells (*g*).

receive impulses by one system of processes and discharge them by another; yet the discharging processes have none of the structural peculiarities of neurites, but closely resemble the receiving processes, which are indistinguishable from dendrites. Again the sensory neurones of the spinal and the cranial nerves (Fig. 1, *d*) have their cell bodies on their length and not terminal, but their distal processes, which by definition should be dendrites, are from the standpoint of structure in all respects neurites, as are their proximal processes. Hence arises the difficulty that in some instances dendrites, though usually receptive in function, may discharge, and neurites though usually discharging in function, may receive. These and other like causes make it clear that any attempt to define neuronic polarity on the basis of dendrites and neurites is foredoomed to failure, for whatever may be the explanation of the difference between the two classes of processes, it is not necessarily connected with the direction in which they transmit impulses. This conclusion, moreover, is supported by what is known of invertebrates. Here it is commonly quite impossible by any of the structural tests used in vertebrates to distinguish dendrites from neurites. In fact the processes at the two poles of the cell seem to be essentially similar and both tend to resemble dendrites.

But in my opinion the chief reason the hypothesis of neuronic polarity as ordinarily stated meets with serious difficulties is not because of the complications that arise when dendrites and neurites are involved, but because nervous activity is commonly described in reference to the cell body of the neurone. Certain parts of the neurone are said to transmit toward the cell body or cellulipitally and other parts are said to conduct away from this body or cellulifugally. But polarity established upon this basis is surely upon very insecure ground, for it involves the assumption that the cell body of the neurone is the center of nervous activity, an assumption which has come down to us from the past, but in support of which little can really be said.

To be sure neurofibrils have been abundantly identified in the cell body of the neurone, but they have never been shown

to extend in any particular way to the structure that is most characteristic of the cell body, namely, the nucleus. Structurally, therefore, there is no special reason for assuming that the nucleus and its surrounding cytoplasm constitute a special nervous center. Moreover, as Bethe (1897, 1898) and Steinach (1899) have shown, certain neurones may continue to function for some considerable time after the removal or destruction of their cell bodies, thus demonstrating very clearly that these bodies are not a necessary part in the internal nervous mechanism of the neurone.

But not only can it be shown that the cell body with its contained nucleus is not essential to the nervous organization of the neurone, it can also be shown that this part has a very definite, specific and non-nervous function of its own. It has come to be an admitted fact in cytology that the nucleus of a cell is in some very direct way essential to the normal metabolism of that element, for when a cell is cut into pieces the non-nucleated fragments are incapable of further growth and invariably die, whereas the nucleated part may regenerate and continue to live. To this rule the nerve cell seems to be no exception, for when a nerve fiber is separated from the rest of the neurone, it invariably undergoes degeneration and death. The nucleated part meanwhile usually remains intact, and is the part from which a new nerve fiber will grow out if one is formed at all. Thus the nucleated and non-nucleated parts of the neurone act in the same way as the corresponding parts of an ordinary cell do and hence it is concluded that the nucleus of the neurone, like that of the ordinary cell, is a structure essentially concerned with metabolism. In this way only is the nucleated part of the neurone necessary to nervous processes. The older neurologists were certainly quite mistaken when they regarded what they called the ganglion cell as the center of nervous activity. It is the metabolic or trophic center of the neurone, but, though it may be invaded by neurofibrils, it is not a seat of special nervous function. Hence how misleading and erroneous is it to discuss the nervous polarity of the neurone as though it centered on the cell body of that structure!

The polarity of the neurone is best described in the statement that nerve impulses are received at one end of it and discharged at the other. From this standpoint polarity is not necessarily associated with dendrites and neurites or with the cell body, but depends upon the positional relations of the neurone as a whole, especially in reference to the rest of the animal's body, including, in particular, other neurones. If one end of a neurone forms a part of a sensory surface, that end naturally serves as the receptive end and the opposite one becomes the region of discharge. If the neurone is imbedded in central nervous organs, its polarity is apparently determined by the nature of the synapses. Thus, though an impulse can be transmitted in either direction within the limits of a single neurone, it can pass from one neurone to another only in one direction. This principle is well illustrated by the Bell-Magendie law as extended by the observations of Gotch and Horsley (1891), Mislawski (1895), Veszi (1909) and others. When a stimulus is applied to the central end of the cut dorsal root of a spinal nerve (Fig. 1), the ventral root exhibits an electrical change and the muscles connected with it contract showing that a nerve impulse has passed through the cord from the dorsal to the ventral side. When on the other hand the central end of a ventral root is stimulated,

no change of any kind whatsoever can be discovered in the dorsal root, showing that the same path can not be traversed in the reverse direction. As intraneural conduction is well known to occur in both directions this interruption is believed to be interneural, that is, synaptic; hence the conclusion that the synapse is a valve-like mechanism that permits the passage of an impulse in one direction only. The polarity of a deep-seated neurone then is determined by its synapse.

If we divest our minds of the assumed nervous significance of the cell body of the neurone and of all the misleading terminology of cellulipetal and cellulifugal conduction in relation to dendrites and neurites, we have left the simple proposition that neurones, though capable of double conduction within themselves, nevertheless conduct normally in one direction only. This is the real and sufficient basis for neuronic polarity. That it is partly dependent upon the synapse is quite obvious. For this and other reasons the synapse has been a matter of much concern to neurologists, but its extreme minuteness has been a baffling feature in its investigation. The researches of His (1886) supported by those of Harrison (1901) and others have shown that in many parts of the nervous system neuroblasts that give rise to contiguous neurones in adult neuronic chains may be in embryonic stages far separated and come together only after considerable growth. Of their initial separation there can be not the least doubt; the question that naturally arises concerns the extent of their final union as they establish synaptic relations. That this can not be complete has already been pointed out in discussing synaptic transmission, but precisely what the incompleteness consists in from a histological point of view is by no means easily determined. Bartelmez (1915) has had the opportunity of studying the synapse under conditions in which the elements were extremely coarse (the Mauthner's cells of fishes) and he finds, as might have been expected, no continuity, but delicate membranous separations. These membranes must be the parts concerned with synaptic activities and hence with the polarity of the neurone so far as it is dependent upon the synapse.

Thus after years of infinite pain and labor the neurologist of to-day can describe in terms of cells the nervous system of one of the higher animals as composed of an intricate association of neurones whose relations to the animal as a whole and to each other through synaptic contact have impressed upon these structures a definite form of polarity.

As this idea of the synaptic nervous system gradually unfolded itself to the more orthodox neurologists, there arose from another school of workers the diametrically opposite conception of the nerve-net. This new movement received its initial impetus chiefly from the work of Apáthy (1897), who maintained on the basis of preparations of almost incredible clearness that the nervous elements of many animals were bound together by a network of neurofibrils in which there was not the slightest evidence of interruption such as is implied in the synapse. This view in a way was a revival of the idea of a continuous network as maintained in a previous generation by Gerlach. The careful reader of Apáthy's papers will find it by no means easy to separate in them fact from speculation and consequently it is difficult to state in exact terms Apáthy's real contribution to this subject, but, however this may be, it is certainly true that the appearance of his publications excited others to a further investigation of the subject with the result that nerve-nets were

proved to exist in a number of animals. They were definitely identified by Bethe (1903) in jelly fishes, by Wolff (1904) and by Hadzi (1909) in hydrozoans, and by Groselj (1909) in sea-anemones. In fact the coelenterate nervous system seemed to be nothing but a nerve-net. Von Uexküll's physiological studies led to much the same conclusion concerning the nervous system of echinoderms. Prentiss (1904) in a brief summary gathered together the evidence to show that nerve-nets were at least components of the nervous systems of worms, arthropods, mollusks and even vertebrates (Fig. 3)

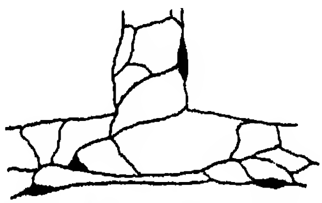


FIG. 3. Outline of a nerve-net from a vertebrate blood-vessel (after Prentiss).

where they were especially associated with the blood vessels (Dogiel, 1893, 1898; Bethe, 1895, 1903; Leontowitsch, 1901; Cavalié, 1902; Prentiss, 1904), including the heart (Dogiel, 1898; Hofmann, 1902; Bethe, 1903). Moreover, it is now regarded as probable that there is a nerve-net associated with the musculature of the vertebrate digestive tube. Thus nerve-nets were identified from the cœlenterates to the vertebrates and some of the more ardent advocates for this type of nervous organization went so far as to assume that it was the only type of nervous structure really extant and that the evidence for a synaptic system rested upon artifacts that obscured the real relations of cell to cell. But this extreme position has not been justified by further research. It is now generally admitted that the conceptions of a synaptic system and of a nerve-net are not opposing ideas, but represent two types of nervous organization, both of which may exist side by side in the same animal (Herrick, 1915; Bayliss, 1915). Judging from the fact that the nerve-net is apparently the exclusive type of nervous organization in the cœlenterates and that it becomes progressively less and less evident the higher one ascends the animal series, it seems fair to conclude that the nerve-net is the more primitive type and that in the course of evolution it has given way more and more to the synaptic system which has finally come to be the dominating plan of nervous organization in the higher animals. From this standpoint one of the higher metazoans might perfectly well possess both types of nervous structure: nerve-nets having been retained in its more conservative portions and synaptic structures having been developed in its more progressive parts. Thus the nerve-net may be regarded as phylogenetically older than the synaptic system.

If this view of the relation of nerve-nets and synaptic systems is correct, there ought to be found in the animal series evidences of transitions from one type to the other. Herrick (1915) has stated very clearly the essential differences between these two types in the declaration that in nerve-nets there are no synapses and no polarity, both of which characterize the more differentiated type. The many illustrations that have been used to show the structure of nerve-nets from the cœlenterates to the vertebrates exhibit continuous diffuse nets without the least suggestion of synapses. Some of the best of these examples are from the subumbrellar surfaces of jellyfishes. Here, too, conduction has been studied for a long time and it has been shown through the work of Romanes (1877) and others that transmission in these regions is as diffuse and gen-

eral as would be expected from the structure of their nets. Probably the only evidence of polarity that these nets exhibit is seen in the temporary condition that has been claimed for them by von Uexküll, namely, that impulses flow for the moment more freely through them into stretched regions than into unstretched regions. Aside from this momentary state they are probably quite unpolarized in their transmitting capacities.

From such a condition as this it ought to be possible to trace the transition stages that have led to the synaptic nervous system, and, in fact, examples of this kind are not difficult to find. As a first step in this direction we may examine the tentacles of sea-anemones. These organs were shown by Ránd (1909) to exhibit in their responses to stimulation a marked polarity. If a stimulus is applied to the tip of a tentacle, the whole tentacle usually shortens. If it is applied to any other point on the tentacle, this organ shortens as a rule only from the point stimulated to the base, the distal portion of the tentacle remaining unchanged. Hence it may be concluded that transmission does not proceed from any region in the tentacle freely in all directions, but only towards its base; in other words, the tentacle exhibits polarity. As this polarity disappears on treating the tentacle with chloretone or other anesthetizing agents, it is clear that it is a nervous polarity. The neuromuscular mechanism of the tentacle is well known to consist of peripheral sense cells whose deep ends are much branched constituting a nerve-net that is applied to the longitudinal muscle cells of the tentacular ectoderm. The polarity of the tentacle depends upon a peculiarity in the structure of the sense cells as pointed out by Groselj (1909), namely, that most of the fibrous prolongations from the deep ends of these cells, instead of spreading out in all directions, extend down the tentacle towards the base. Hence, when the sense cells are stimulated, nerve impulses are generated, which, in consequence of the direction of the cell fibers, are conducted into the proximal portion of the tentacle, where they call forth the contraction of the longitudinal muscle cells. Here then is the first evidence of permanent nervous polarity such as is so clearly shown in the neurone. It occurs in a nerve-net without synapses, but so organized that its fibrous constituents, instead of being diffusely arranged, have a predominating trend in one direction.

Judging from the nature of the responses, polarized nerve-nets occur in many other places. Thus the stalk of the giant hydrozoan, *Corymorpha*, has recently been shown to transmit nervous impulses more freely on its length than transversely, a condition that immediately suggests a locomotor waves that pass over the foot of a creeping snail are believed with good reason to depend upon the presence of a nerve-net, in which case the net must be strongly polarized, for these waves are limited in almost every instance to a single direction. In a similar way the peristalsis of the vertebrate digestive tube implies a polarized net in the wall of that structure.

Thus the primitive, diffuse, or apolar, nerve-net may be imagined to undergo the first change toward a synaptic system by becoming polarized, a process that may be described as due to a lengthening of its fibers in one direction, whereby transmission in that direction predominates over transmission in any other. The cells whose processes exhibit this change are the ordinary sense cells and nerve cells of the nerve-net. They may be looked upon as the forerunners of neurones, protoneurones so to speak, and from them have arisen by further differentiation the highly special-

ized nerve cells of the synaptic system. Thus we can picture to ourselves the initiation of that process which resulted in the production of longer and longer transmission tracts such as we find in the central nervous organs of the higher animals, whereby nerve cells once near neighbors come to be widely separated. In their ontogenetic recovery of connections thus temporarily lost they seem to have failed to reestablish a complete union. This feature of partial recovery, at first a mere incident of growth, contained within it a germ of first importance, for out of it was differentiated the synapse, a device that reinforced the original polarity of the nerve cell and established a new range of nervous possibilities from which have evolved those highly organized adjustments that make the abode of man's intelligence, his cerebral cortex, so different from the nerve-net of his digestive tube.

It will be interesting as new discoveries are made in this field of research to follow in detail the transition from the nerve-net to the synaptic system. At present little is known about this subject, but a very suggestive and interesting contribution has been made to it by Moore (1917). It has long been known that strychnine greatly heightens the reflex excitability of many animals and it has been commonly assumed that this action is due to the reduction under the influence of this drug of the synaptic resistances. This being the case strychnine may be used as a test for the presence of synapses. From this standpoint Moore's results are of extreme interest, for he has found that the drug has no effect on the neuromuscular responses of cœlenterates, a slight one on echinoderms, and a much greater one on crustaceans and mollusks, a series that leads up to the well-known condition in vertebrates and suggests in its continuity that the effects are dependent upon the appearance and degrees of differentiation of the synapse.

Although the nucleated portion of the nerve cell, be it a protoneurone or a neurone, is the trophic center and not the nervous center of this element, the migrations that this part undergoes in the course of evolution are not without interest. Two lines of movement are observable, one seen in the receptive cells and the other in those of the nerve-net proper.

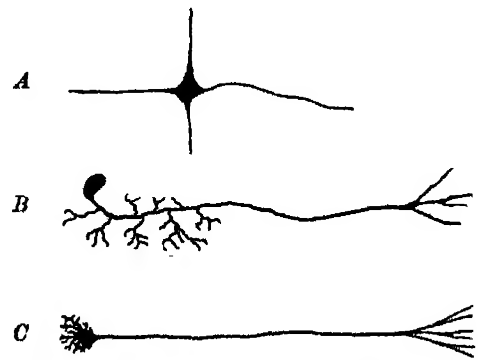


FIG. 4. Motor nerve-cells; *A*, motor cell from the nerve-net of a cœlenterate; *B*, motor neurone from an earthworm; *C*, motor neurone from a vertebrate. In examples *B* and *C* the central ends of the cells are toward the left.

In the primitive protoneurones of the nerve-net in cœlenterates (Fig. 4, *A*) the cell body with its contained nucleus is almost always centrally located, its processes being in direct connection with those of other like elements. In nerve-nets that exhibit polarization and thus begin to take on the character of differentiated nerve centers, the cell bodies are nearer the receptive than the discharging ends. This is best seen where the process has more nearly reached completion as in the central nervous organs of worms, arthropods and mollusks (Fig. 4, *B*). Here the cell bodies, usually unipolar, are attached to the transmitting axis of the neurones near their receptive poles, and this condition foreshad-

ows the final stage of this process as seen in vertebrates where the cell bodies are almost invariably at the receptive ends of centrally situated neurones (Fig. 4, *C*). Thus, in the evolution of the protoneurone of the nerve-net into the neurone of the specialized central organ, the cell body migrates from a central position to a polar one at the receptive end of the neurone.

The second type of migration is quite the reverse of that just described. It is seen in the sense cells of the nerve-nets and in those cells that are derived from them and that are associated with the more differentiated sensory surfaces of the higher animals. This type of migration was long ago pointed out by Retzius (1892) and his account needs only to be supplemented by what is now known of the cœlenterates in order to bring it thoroughly up to date. In the cœlenterates the sense cell, or receptive protoneurone, has its cell body at its receptive end whence its fibrous prolongation reaches into the nerve-net (Fig. 5, *A*). Much the same condition is found in the earthworm, though in many other worms the cell body has moved to a deeper position, leaving only a process of the cell in connection with the sensory surface. In mollusks this inward migration of the cell body is still more pronounced (Fig. 5, *B*.) And finally in vertebrates (Fig. 5, *C*), the cell body of what has now become the primary receptive neurone has migrated so far inward as to come to lie much nearer to the central nervous organ than to the peripheral receptive surface from which it started. Thus in the two types of cells, peripheral and central, the directions of migration are opposite, for while in the primary sensory neurone the cell body has moved away from the receptive pole, in the central neurone it has moved to that pole.

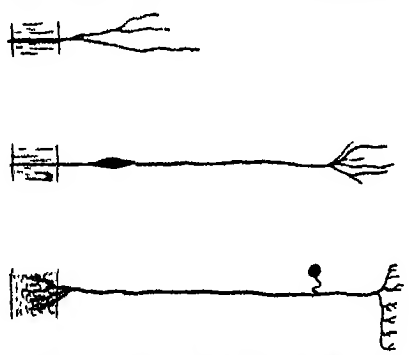


Fig. 5. Sensory nerve-cells; *A*, sensory nerve-cell from a cœlenterate; *B*, sensory neurone from a mollusk; *C*, sensory neurone from a vertebrate. In each example the peripheral end of the cell is toward the left.

These migrations, in my opinion, are not to be interpreted as direct expressions of nervous changes in the neurone, as would probably have been surmised by the older school of neurologists. They are the migrations of the trophic center of the cell and they probably find their explanation in the changed metabolic needs of the evolving neurone rather than in its immediate nervous changes. Something of what these relations are may be gathered from the conditions presented by the receptive neurones of the chemical senses of vertebrates. Of these the most primitive are the olfactory neurones in which the trophic center is at the receptive end of the cell (Fig. 6, *A*) reproducing in this respect the conditions found in the integument of sea-anemones and of earthworms. Next in sequence are the receptive neurones of the common chemical sense (Fig. 6, *B*) in which the trophic center has migrated far inward toward the central organ, a strictly vertebrate condition. The last members of the series are the receptive neurones of the sense of taste (Fig. 6, *C*), which are like those of the common chemical sense, except that they have appropriated distally certain integumentary cells, often called sec-

ondary sense cells, that constitute a taste bud.

These three types of chemical sense organs, genetically related in the order just given, show most interesting physiological differences. Some few substances, like ethyl alcohol, stimulate all three, but at strikingly different concentrations (Parker and Stabler, 1913). If the dilution that will just stimulate the most sensitive of the three, the olfactory neurones, is expressed as unity, the concentration necessary to stimulate the terminals of the common chemical neurones is 80,000 and of the gustatory apparatus 24,000. Hence it appears that when the trophic center is at the receptive end of the neurone, as in the olfactory organ, that end is thousands of times more sensitive than when this center has migrated away from it, though it can recover some of its lost sensitivity by appropriating to itself neighboring cells whose nuclear activity may make good in some measure that which was lost by the inward migration of its own trophic center. Why these centers in the course of phylogeny should have migrated from their original superficial positions inward over much of the length of their neurones is difficult to say. Possibly it may have

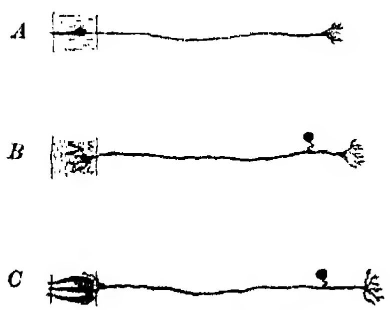


Fig. 6. The primary neurones of the three chemical senses of vertebrates; *A*, olfactory; *B*, common chemical; *C*, gustatory. In each example the peripheral end is toward the left.

been due to the advantages of increased nutritive opportunities in these deeper situations or to the establishment of a second and deeper receptive surface for other systems of neurones.

If, as seems to be the case, the proximity of the trophic center greatly enhances the sensitivity of the receptive pole of a neurone, it is easy to understand why in the differentiation of the protoneurones of the nerve-net into the central neurones of the synaptic system the trophic center should migrate toward the receptive pole of the neurone. Such a step is only another aspect of that whole series of changes that give the synaptic system its high efficiency as compared with that of the nerve-net.

It might seem at first sight that the migrations that have been discussed are the cellular aspects of the general migrations of nerve centers that have been ably and interestingly expounded by Kappers (1907–1917) and his followers, under the head of neurobiotaxis. But these migrations, as a moment's reflection will show, are strictly concerned with nervous operations and have to do with the association of groups of neurones in connection with developing reflexes rather than with what may be called the inner life of the neurone. The neurobiotaxes, therefore, are not to be confused with those intraneuronic shifts whereby the trophic center of the nerve cell is placed in such a position as to administer most efficiently to the metabolic needs of the neurone. These shifts give evidence of the interrelation of the prime factors involved in the organization of every nerve cell, the metabolic and the nervous. Those two factors have been most important in shaping the evolution of this element, but they have not always received at the hands of investigators that separate attention which they deserve. It is one of the objects of this address to emphasize

their separateness without, however, losing sight of their intimate interdependence.

G. H. Parker

Harvard University

ROLLIN ARTHUR HARRIS

Dr. Rollin Arthur Harris, of the U. S. Coast and Geodetic Survey, died suddenly of heart disease on the twentieth of January, 1918, in the fifty-fifth year of his age. He was born in Randolph, N. Y., April 18, 1863, and received his early education in the public schools and high school of Jamestown, N. Y. In 1881 he entered Cornell University, receiving the degree of Ph.B. in 1885. He remained at Cornell, taking up graduate work in mathematics and physics. In 1886–7 he was a fellow in mathematics and in 1888 he received the degree of Ph.D. From 1889 to 1890 he was a fellow in mathematics at Clark University where he pursued special studies in mathematics and lectured on mathematical subjects.

He entered the Tidal Division of the U. S. Coast and Geodetic Survey as computer in 1890, through the United States Civil Service. After becoming familiar with the work, he began the preparation of a publication into which would be gathered the tidal information scattered in various journals and memoirs and in which the methods of tidal reduction and prediction would be coordinated. Dr. Harris threw himself into the work with enthusiasm. Because of his splended training in mathematics and his ability, he was specially fitted for the work, and the result, as embodied in the "Manual of Tides," which appeared in six parts in various reports of the superintendent of the Coast and Geodetic Survey, between the years 1884 and 1907, has placed our country well at the front in that branch of scientific enquiry. Taken as a whole the "Manual of Tides" is a monumental work of some 1,200 quarto pages of text and plate containing a large amount of original contributions, in a field cultivated by the most brilliant mathematicians.

It is gratifying to know that the "Manual of Tides" has received the recognition it merited from scientists the world over. Perhaps it may not be out of place here to quote the words of the eminent French mathematician Henri Poincaré. In his "Mécanique Céleste" he subjects the various tidal theories to searching analysis and sums up by saying that "it appears probable that the final theory will have to borrow from that of Harris a notable part of its essential features."

Dr. Harris published a number of articles in Science and other scientific journals on mathematical and tidal subjects. Mention should also be made of "Arctic Tides," a monograph published by the Coast and Geodetic Survey in 1911 which is a classic of its kind.

Personally, Harris was a man of modest bearing, somewhat reticent, but possessed of a pleasing sense of humor. He was an indefatigable worker with a high conception of the obligations of the scientist. He was a member of scientific societies, both local and national. He leaves a widow, Emily Doty Harris, whom he married in 1890.

His loss will be felt by his friends and colleagues of the Coast and Geodetic Survey and by the many scientific men, engineers and explorers in many parts of the world, who brought their problems to him and received the benefit of his wide knowledge in a peculiarly abstruse branch of science.

SCIENTIFIC EVENTS

DR. FEWKES AND THE BUREAU OF AMERICAN ETHNOLOGY

Mr. Frederick Webb Hodge, who has been the head of the Bureau of American Ethnology of the Smithsonian Institution since 1905, has resigned to accept a position in connection with the Museum of the American Indian, founded by George G. Heye, of New York City. Mr. Hodge's resignation, to take effect February 28, has been accepted with regret by the secretary of the Smithsonian Institution, with whom he has been associated in scientific work for many years. Mr. Hodge will be greatly missed by his associates and generally by the men of Washington's scientific colony, among whom he is well known.

Dr. Jesse Walter Fewkes, a distinguished archeologist and naturalist, has been appointed chief of the Bureau of American Ethnology in Mr. Hodge's place. Dr. Fewkes has been an ethnologist on the Bureau's staff since 1895 and is a member of the National Academy of Sciences and of many scientific societies in this country and abroad.

Dr. Fewkes is a graduate of Harvard University, with the degrees of A.M. and Ph.D. He was a student in the University of Leipsic, Germany, from 1878 to 1880; served as assistant in the museum of comparative zoology at Harvard University from 1881 to 1890; was a member of Louis Agassiz's school at Penikese Island and had charge of the laboratory of Alexander Agassiz, at Newport, Rhode Island, for four seasons. He was secretary of the Boston Society of Natural History from 1885 to 1890. During this year, while in California studying marine zoolgy, he became deeply interested in the aborigines of the southwest and gave up natural history to devote himself entirely to the ethnology of the Indians of New Mexico and Arizona. For five years he had charge of the Hemenway Expeditions organized for the study of the southwest Indians, at Zuni and Hopi. In 1895 he was appointed an ethnologist in the Bureau of American Ethnology. He is preeminently a field worker, and the record of his original researches on archeological subjects can be found in the *Journal of American Ethnology*, of which he was editor, and in the Bulletins and Reports of the Bureau of American Ethnology and the Smithsonian Institution. He has made extensive collections of ancient pottery and other prehistoric aboriginal objcts, the more notable of which are now on exhibition in the National Museum.

One of the important lines of work inaugurated by Dr. Fewkes was the repair of the large ancient ruin, consisting of several compounds composed of massive buildings, known as "Casa Grande" in southern Arizona and cliff dwellings and other ruins in the Mesa Verde National Park, Colorado. Previously to this work, no care was taken by archeologists to repair and otherwise preserve from rapid destruction the prehistoric buildings they had excavated. An increased interest in these antiquities led to their protection by the government and to the limitation of work on them to systematic scientific investgators. Up to the present time four large ruins on the Mesa Verde—viz., Spruce-tree House, Cliff Palace, Sun Temple, and Far View House—have been preserved in this manner under his direction.

Some of the scientific writings of Dr. Fewkes are: "The Snake Ceremonials at Walpi"; "An Archeological Expedition to Arizona in 1895"; "Two Summers' Work in Pueblo Ruins"; "Casa Grande, Arizona"; "Excavation and Repair of Spruce-tree House"; "Cliff Palace"; "Sun Temple"; and "Far View House." To meet the increasing desire for archeological information on the West Indies, after the close of the Spanish War, several visits were made by him to Porto Rico, a report on which was published in an elaborate memoir, "The Aborigines of Porto Rico and Neighboring Islands."

Dr. Fewkes has received the degree of LL.D. from the University of Arizona, was made a Knight of the Order of "Isabela la Catolica" by the queen regent of Spain in 1872, and was the recipient of a gold medal from King Oscar of Sweden for his archeological researches.

PUBLIC-HEALTH ADMINISTRATION IN RUSSIA

RUSSIA, with about 180,000,000 inhabitants, 85 per cent. of whom live in the rural districts, has developed a combined system of free medical care and health protection for her rural population to a point which is unique and of which we are only beginning to dream. This is a statement of Professor C.-E. A. Winslow, professor of public health at the Yale Medical School, and member of the Red Cross Mission to Russia in 1917, who, in *Public Health Reports*, as quoted by the *Journal* of the American Medical Association, gives the history and many details of the public-health administration in that country which he studied in the past year during the revolution.

Previous to the creation of the zemstvos in 1864 by Alexander II., hospitals had been established and medicine had developed chiefly in

the cities. Thirty-two provincial hospitals with 6,200 beds, and 303 district hospitals with 5,100 beds were turned over to the zemstvos, all in poor condition and badly mismanaged, without adequate provisions for isolation or care of communicable diseases. An effort was begun to give medical service free to the rural inhabitants, and by 1870 the zemstvos had arranged a system of fixed medical districts, each provided with a small hospital and a qualified physician. By 1890 there were 1,422 zemstvo medical districts with 1,068 hospitals of 26,571 beds and 414 dispensaries, and the number of their physicians had increased from 756 to 1,805, and the number of nonmedical assistants from 2,749 to 6,788. The tendency has been to make all hospital and dispensary treatment free, the care of the sick being recognized by the zemstvos as a natural duty of society rather than an act of charity. Thus the public care of patients developed first and preventive work developed as an offshoot, both being now closely related.

The province of Moscow is said to have the most highly developed organization for the promotion of zemstvo medicine. It supports a hospital for every 10,000 to 15,000 inhabitants, each with from twenty to sixty beds, an average of two physicians, two medical assistants and four sister nurses. Each of the larger hospitals assigns a certain number of beds for general use, for communicable diseases and for maternity cases; each has its dispensary, and all medicines, as well as medical care, are given free; home visits are made only in serious cases. Financial aid is often given to women in childbirth and to invalids unable to go to the hospital. Separate provision is made for mental cases. For prevention, Moscow province is divided into thirteen sanitary districts, with full time medical supervisors, and assistants, and there is a central statistical division, a laboratory and a vaccine institute. There is also a sanitary council for each district and one for the whole province, with district physicians, factory physician and others, all under the control of the provincial and district zemstvo assemblies, working under a sanitary code which was in force before the revolution.

The principal developments of Russian public health have been along medical and bacteriologic lines, in the control of the more acute communicable diseases and in the field of vital statistics. The statistical bureaus of the central council of public health and of the larger cities are better equipped with funds and with highly trained specialists than our own. The bacteriologic and chemical laboratories are also highly developed and in charge of high grade men with leisure and inclination for productive research. Sanitary engineering is somewhat neglected, but when the time comes its development will be fruitful. The most important future development of public health in Russia, as elsewhere, Winslow believes, must be along educational lines in venereal diseases, tuberculosis and infant mortality, and the largest single task is the last. The great strategic point in the Russian health situation is the remarkable development of social medicine along curative lines and the close connection between curative and preventive work. The opportunity for developing educational preventive work in connection with such a system is practically unlimited.

NATURAL HISTORY COLLECTION FOR THE WELSH MUSEUM

We learn from the London *Times* that a valuable collection of insects, shells and minerals has been presented by Lord Rhondda to the National Museum of Wales. The collection was formed by the late Mr. Robert H. F. Rhondda was led to purchase the collection by the result of over fifty years' work. Lord Rhondda was led to purchase the collection by the reports submitted by the specialists who examined it, Miss Bowdler Sharpe and Mr. J. Davy Dean, and the majority of the specimens being exotic, the collection will supplement the specimens already in the museum, which are mostly British.

The *Times* states that Mr. Rippon was a talented artist and musician, as well as a great naturalist, and both wrote and illustrated his work on "Icones Ornithopterorum." He devoted a great amount of time to the care of his collections, and Dr. W. E. Hoyle, director of the museum, states that as a consequence the

condition of his specimens leaves little to be desired. The insects in the collection number over 100,000, and the shells 52,000. Mr. Rippon's great wish was that his collections should not be broken up, but that they should have some home where they could be of public or private use.

The Rippon collection will enable the National Museum of Wales to teach natural history in a way it could not attempt without such ample resources. It will also enable the student to examine exotic types and be of great aid to the specialist in the determination of species. So complete is the series that such gaps as occur, either in the insect collection or the shell collections, can be easily filled as opportunity offers in the future. Many of the larger and more curious shells and insects are familiar through the pages of standard works on general natural history. No illustration in any book could, however, do justice to the wonderful coloring of some of these exotic insects. An idea of the extent of the collections in the Lepidoptera alone will be gained when it is stated that in the Papilionidæ (the Swallow-tails) there are over 3,000 specimens, and in the Nymphalidæ (or Fritillaries) there are over 5,000. Dragon-flies, May-flies, crickets, grasshoppers, the wonderful stick and leaf insects of the tropics, the many and curious flies belonging to the order Diptera, the beetles or Coleoptera which number over 40,000 specimens, the ants, bees and wasps or Hymenoptera are too numerous to do more than mention.

The shells, or Mollusca, are exceedingly numerous and well represented in all the large and beautiful forms from the coral reefs of the Pacific, among which may be mentioned the Cones, Cowries, Olives, Woodcock shells, Volutes, and many others. There is an example of the rare Orange Cowry, used by the natives of Fiji and New Caledonia as a badge of royalty, and many Volutes for which high prices have been given. Many large and beautifully colored bivalve shells crowd the cabinets.

The collection of minerals comprises about 3,000 specimens many of which are from such widely distant parts as Siberia, Japan, South America, etc., all carefully named according to Dana's Manual.

THE BRITISH MUSEUM AND THE WAR

The British government has been induced to abandon the intention to use the British Museum at Bloomsbury for the purposes of the Air Board and the Natural History Museum at South Kensington for other government departments. Lord Sudeley directed attention to the proposed appropriation of these buildings in a question asked in the House of Lords on January 9, and, in reply, Earl Curzon said that, as regards the British Museum, he was glad to state that for the accommodation of the Air Ministry it was no longer necessary to appropriate that building. As to the Natural History Museum, it had been found, after detailed examination, that any attempt to convert the galleries into public offices would involve the closing of the building to the public, extensive internal rearrangements, and the consumption of an enormous amount of labor and material and very considerable delay. In these circumstances it had been decided that there was no necessity sufficiently urgent to warrant the use of the museum as had been contemplated. *Nature* remarks:

This decision has given much satisfaction to all who cherish regard for national prestige and understand the intellectual stimulus or practical value of the collections in our national museums. What astonishes us, however, is that Sir Alfred Mond, the First Commissioner of Works, and a son of the late Dr. Ludwig Mond, should have placed himself in such an indefensible position by putting the scheme before the government. It is difficult to comprehend also why, before deciding to requisition the building, the government did not inquire as to whether such action was imperatively needed, and consult the trustees and other responsible authorities as to what its consequences would be. If that had been done, a storm of protest would have been saved, and Earl Curzon would not have had to confess in the House of Lords that there was no real necessity for the proposed occupation, which would, indeed, have been more like the act of an invader than of a government entrusted with the care of national interests in every direction. The trustees of the museum, at

their meeting on January 12, expressed their gratitude, on behalf of the nation whose treasures they hold in trust, to the newspapers which so unanimously gave voice to the public disapproval of a proposal which threatened the safety of the museum and its collections.

SCIENTIFIC NOTES AND NEWS

Memorial exercises were held at the Johns Hopkins University on February third, in commemoration of Professor Franklin Paine Mall. President Goodnow presided and addresses were delivered by Professor Florence R. Sabin, Professor Lewellys F. Barker, Professor William H. Welch, of the Johns Hopkins Medical School, and President Robert S. Woodward, of the Carnegie Institution of Washington.

Surgeon-General Sir Alfred Keogh, director-general of British Army Medical Services, has been permited to resume his duties as general executive officer to the Imperial College of Science and Technology, and will be replaced at the War Office from March 1 by Colonel T. H. J. C. Goodwin, Royal Army Medical Corps, until recently the assistant director of medical services to the British Recruiting Mission in America. He will be appointed acting director-general of the Army Services.

Director Russell H. Chittenden, of the Sheffield Scientific School and professor of physiology at Yale University, has left for Europe to represent the United States on an important Government commission to England, France, and Italy. He will probably be away for a period of from three to six months. During his absence Professor Percey F. Smith, will be the acting director of the Sheffield Scientific School.

Dean Philip A. Shaffer, of Washington, University and major in the food division of the Surgeon--General's Office, Washington, D. C., is making a tour of the cantonments, before leaving for France to take charge of the food division with the expeditionary forces.

Dr. Frank Schlesinger, director of the Allegheny Observatory, has been appointed aeronautical engineer in the U. S. Signal Corps. He will have charge of the instruments that are mounted on aeroplanes and will form the connecting link between the construction department of the Signal Corps and the National Research Council. During his temporary absence from the observatory Dr. Frank C. Jordan will be in charge.

Dr. C. Judson Herrick, professor of neurology in the University of Chicago, has recently been commissioned major in the Sanitary Corps of the National Army and has been assigned to active service as neurohistologist in the neurosurgical laboratory of the Surgeon-General's Office, located at the Johns Hopkins Medical School, Baltimore.

Professor Bradley M. Davis has been granted leave of absence from the University of Pennsylvania to take up work with Dr. Raymond Pearl in the Statistical Division of the Food Administration, Washington, D. C.

Mr. E. A. Goldman, of the Bureau of Biological Survey, U. S. Department of Agriculture, has been commissioned a major in the Sanitary Corps of the National Army, for the purpose of investigating methods for the control of the rat pest in its relations to the army. As is well known, the common house rat exists in enormous numbers both in this country and especially in France, where it is reported to transmit certain diseases among the soldiers.

Dr. K. L. Mark, head of the chemistry department and of the school of general science at Simmons College, Boston, has been granted a leave of absence for the duration of the war to accept a commission as captain in the Sanitary Corps of the Army.

Among the professors of the State University of Iowa and instructors who have joined the colors recently are: B. P. Fleming, professor of mechanical engineering, captain in the engineering corps; H. B. Whaling, associate professor in the newly organized school of commerce, aviation; F. C. Brown, associate professor of physics, captain in the ordnance division, Washington, D. C.; I. L. Pollock, instructor in political science, United States War Trade board, Washington, D. C.; D. A.

Armbruster, physical training department, aviation; A. R. Fortsch, physics department, private at Camp Dodge; R. H. Sylvester, assistant professor of psychology, psychological division of the medical officers' training camp, Fort Oglethorpe, Georgia.

Professor Rollin D. Salisbury, head of the department of geography and dean of the Ogden graduate school of science at the University of Chicago, was presented with the Helen Culver gold medal of the Geographic Society of Chicago at a banquet in the Hotel Sherman, Chicago, on January 26. The occasion marked the twentieth anniversary of the society, of which Professor Salisbury was the first president.

Dr. Griffith Taylor, of the Australian Bureau of Meteorology, has been awarded the gold medal of the Royal Geographical Society of Queensland, for his work on the settlement of tropical Australia.

Officers of the Association of American Geographers have been elected as follows: *President,* Nevin M. Fenneman; *First Vice-president,* Charles R. Dryer; *Second Vice-president,* Bailey Willis; *Secretary,* Oliver L. Fassig; *Councilor,* Walter S. Tower; *Treasurer,* François E. Matthes.

The American Geographical Society of New York has elected the following officers: *President,* John Greenough; *Vice-president,* Anton A. Raven; *Foreign Corresponding Secretary,* William Libbey; *Treasurer,* Henry Parish; *Councilors,* Banyer Clarkson, Edwin Swift Balch, W. Redmond Cross, Walter B. James, M.D., H. Stuart Hotchkiss.

With the purpose of securing desirable material from various sources for the Scientific Exhibit at the Chicago meeting of the American Medical Association an advisory committee on scientific exhibits has been appointed consisting of Dr. Harlow Brooks, New York; Dr. A. S. Warthin, Ann Arbor; Dr. George L. Dock, St. Louis; Dr. L. B. Wilson, Rochester; Dr. E. R. LeCount, Chicago; Dr. Oskar Klotz, Pittsburgh; Dr. F. P. Gay, Berkeley; Dr. C. C. Bass, New Orleans; Dr. W. M. L. Coplin, Philadelphia; Dr. Joseph C. Bloodgood, Baltimore, and Dr. Walter B. Cannon, Boston.

Dr. I. W. E. Glattfeld has been appointed a member of the committee on the supply of organic chemicals for research during the war.

J. A. McClintock, plant pathologist, of the Virginia Truck Experiment Station, has accepted a position with the United States Department of Agriculture, as extension pathologist, in charge of cotton, truck and forage crop disease investigations in Georgia, with headquarters at the State University, at Athens.

Professor George J. Young, recently professor of mining in the University of Minnesota, and previously in the Mackay School of Mines at Reno, Nev., has joined the editorial staff of the *Engineering and Mining Journal* as assistant editor-in-chief.

Miss Grace MacLeod has become assistant editor of the *Journal of Industrial and Engineering Chemistry.* Miss MacLeod holds the degree of S.B. from the Massachusetts Institute of Technology and of M.A. from Columbia University, and for the past seven years has been instructor in chemistry at Pratt Institute, Brooklyn, N. Y.

Dr. W. J. Lenz has severed his connection with the Lenz Apparatus Co., New York, in order to devote his time to his manufacturing interests.

Mr. Victor Yngve has been engaged as research chemist by the Oldbury Electro Chemical Company of Niagara Falls, N. Y., and will have charge of their research laboratory.

Mr. Howard B. Bishop has severed his connection with the General Chemical Co., at Easton, to accept a postion with the National Aniline and Chemical Co.

Dr. F. E. Chidester, chairman of the course in biology and sanitary science and professor of zoology at Rutgers College, has been granted sabbatical leave of absence for the second term of the collegiate year. He will spend some time in research at the University of Pennsylvania, also visiting other institutions to secure ideas for the further development of public health instruction in the State of New Jersey.

Mr. C. William Beebe, curator of birds in the New York Zoological Park, has returned from the Tropical Research Station established last year in British Guiana by the New York Zoological Society. While the intention of Mr. Beebe's short trip was principally to salvage books and instruments until after the war, and to seek rest from an airplane accident, yet opportunity was found for a month of investigaion.

The program of the Indian Science Congress held in Lahore from January 9 to 12, included three evening lectures, open to the public. The first was on "Some simple living things—parasitism and disease" by Major Norman White, sanitary commissioner to Government of India illustrated by cinematograph. The second was on "Aviation" by Lieutenant-Colonel G. M. Griffith, commandant, of the Royal Flying Corps in India, and the third on "The planetry system, ancient and modern," by Dr. D. N. Mallick. The program also included a visit to the railway workshops, an aviation display if not prevented by military exigencies and a scientific conversazione.

Dr. David Eugene Smith, of Columbia University addressed the Association of Teachers of Secondary Mathematics, of North Carolina, in Greensboro on February 1 and 2. He gave a popular lecture on "The origin of mathematics," a somewhat more technical one on "Deficiencies in present preparatory mathematics" and a round table discussion on the topic "A proper approach to elementary mathematics." W. W. Rankin, Jr., of the University of North Carolina, was elected president of the convention.

Professor Ellery Williams Davis, dean of the college of arts and sciences and head of the department of mathematics of the University of Nebraska, died on February 3 from pneumonia after a short illness, at the age of sixty years.

The death is announced at Dorchester, Mass., of Paul S. Yandel, known for his observations on variable stars, at the age of seventy-three years.

Dr. Charles L. Parsons, the secretary, writes that after consultation with the advisory committee and other members of the American Chemical Society, the directors have voted to omit the spring meeting of the society, which was to have been held in St. Louis the coming April. It is felt that the transportation conditions are such that unnecessary travel should be avoided, and also that the chemists of the country are so busily engaged in meeting war needs that their work should not be interrupted for the purpose of conference at this time. The annual meeting of the society will be held in Cleveland, Ohio, in September.

The New York Section of the Société de Chimie Industrielle, was organized at a meeting held at Rumford Hall of the Chemists' Club, on the evening of January 18, 1918. The following officers were elected: *President*, L. H. Baekeland; *Vice-president*, Jerome Alexander; *Treasurer*, George F. Kunz; *Secretary*, Charles A. Doremus. *Council:* Charles Baskerville, M. T. Bogert, Ellwood Hendrick, R. E. Orfila, E. P. Verge, Henri Blum, Charles F. Chandler, W. H. Nichols, G. E. Valabrégue, Henri Viteaux. Professor Grignard, and Lieutenant René Engel, of the French Military Mission, were elected honorary members. The section has about 160 charter members.

The California Academy of Sciences announces lectures for January and February as follows:

January 16. Professor E. C. Starks, department of zoology, Stanford University, "The sea lions of the Pacific coast of America." (Illustrated.)

January 20. Professor R. W. Doane, department of entomology, Stanford University, "Forest insects." (Illustrated.)

January 27. Professor J. C. Bradley, department of entomology, Cornell University, "Experiences in a Georgia swamp." (Illustrated.)

February 3. Dr. J. Rollin Slonaker, department of physiology, Stanford University, "Bird life as seen through the camera." (Illustrated.)

February 10. Dr. Roy E. Dickerson, curator of invertebrate paleontology, California Academy of Sciences, "California petroleum." (Illustrated.)

At the annual meeting of the State Microscopical Society of Illinois, which was founded in 1868, at the Chicago College Club on January 15, the following officers were elected: President, N. S. Amstutz; First Vice-president, Dr. C. H. de Witt; Second Vice-president, Shelby C. Jones; Secretary, Chas. A. Ruhl; Corresponding Secretary, Dr. Vida A. Latham; Treasurer, Frank I. Packard; Curator, Henry F. Fuller; Trustee for five years, Paul R. Wright. The board of trustees now consists of Dr. Lester Curtis, David L. Zook, F. T. Harmon, Dr. J. A. Hynes, Paul R. Wright. During the year monthly meetings were held except during July, August and September as follows:

February—Dr. B. Gruskin—"Celloidin cuttings."

March—Mr. S. F. Maxwell—"The habits of insect life."

April 20—Dr. E. M. Chamot, of Cornell University, gave an illustrated lecture before a joint meeting of the Microscopic Society and the Chicago Section of the American Chemical Society on "Chemical microscopy" at the City Club.

The May meeting was given over to a very successful Soirée held in conjunction with the Chicago Academy of Sciences in the Academy Building, Lincoln Park, at which 58 microscopes among other attractions were exhibited to nearly 500 visitors.

June, an open meeting on "Pond life under the microscope."

October, the president on "Mechanical features of the microscopes."

December—Dr. Geo. E. Fells—"The detection of forgeries by the microscope."

The president's annual address related to "Enlarged industrial applications of the microscope."

We learn from *Nature* that the Science Museum, South Kensington, was reopened to the public on January 1. The museum has been closed to the public for nearly two years; it has, however, been open without interruption for students. As compared with 1914 conditions, the extent and the hours of opening for 1918 are somewhat reduced, but the greater part of the museum will be open free on every week day from 10 A.M. to 5 P.M., and on Sundays from 2:30 P.M. to 5 P.M. The collections contain many objects of interest as representing discoveries, inventions, and appliances that have been of first-rate importance in the advancement of science and of industry, such as Watt's engines, early locomotives, steamships, flying machines, reaping machines and textile machinery.

The National Advisory Committee for Aeronautics has issued a pamphlet entitled "Report No. 13.—Meteorology and Aeronautics." It is a handbook in which are discussed the properties and general phenomena of the atmosphere which aeronauts and aviators should understand. This report was prepared by the subcommittee on the Relations of the Atmosphere to Aeronautics, of which Professor Charles F. Marvin, chief of the Weather Bureau is chairman. In particular the report deals with the physical properties and dynamics of the atmosphere, topographic and climatic factors in relation to aeronautics, and current meteorology and its use. Copies may be had on application to the National Advisory Committee for Aeronautics, Munsey Building, Washington, D. C.

Dr. Addison, minister of reconstruction in the British government recently in London, declared his belief in the urgent need of creating a Ministry of Health with widly decentralized powers and of bringing its machinery into thorough working order before the end of the war. He stated that he had been specially invited by the Prime Minister to cope with this, one of the most important of the many problems of reconstruction. The public conscience was fully alive to the obligations of the state in regard to it, and was not in the mood to brook any further dilatoriness. But the national administration of public health through such a ministry as they contemplated must necessarily impinge on many interests, and it was necessary to bring those interests—insurance, local government, medical and others—into substantial agreement before legislation could usefully be framed, since Parliament had not the time to debate highly contentious proposals. That was the

only reason for the reply recently given by the government in the House of Commons to a question regarding legislation for the creation of a Ministry of Public Health. He appealed, therefore, to all interests concerned to sink minor differences and to approach the problem of public health administration as a whole from the broad national standpoint and in a courageous spirit.

EDUCATIONAL NOTES AND NEWS

A committee consisting of Regent Schulz and Deans Thatcher and Vance has been appointed to plan the celebration of the fiftieth anniversary of the establishment of the University of Minnesota. The inauguration of President Burton will be one of the chief features. In view of the war conditions the celebration is planned to be of state interest only.

The Harvard summer engineering camp at Squam Lake, N. H., has been abandoned on account of the war and owing to the fact that the expenses of the camp can not be met unless more than the thirty students already registered attend.

At Louisiana State University, Assistant Professor S. T. Sanders has been made head of the department of mathematics, and Dr. I. C. Nichols has been appointed associate professor.

Mr. Roy Richard Denslow, assistant tutor in the department of chemistry, College of the City of New York, has been appointed instructor in Smith College.

DISCUSSION AND CORRESPONDENCE

LUMINOSITY OF RECTIFIER ELECTRODE

To the Editor of Science: In setting up as a demonstration experiment, the well-known arrangement for rectifying an alternating current, the essential part of which is an aluminum rod and lead plate in ten per cent. sodium phosphate solution, the following observation was made, which may be well known but which I wish to take this opportunity of mentioning, since I have not found it described anywhere in connection with the experiment.

When the aluminum rod is positive, that is to say, when the current is in such direction that it will not pass through the rectifier, a very distinct luminosity appears over the surface of the aluminum and if the applied potential is as high as 250 volts, this luminosity becomes quite brilliant enough to be observed by a spectroscope. This is not due to local heating since the aluminum is only gently warmed. The glow is orange yellow in color and, through a direct-vision spectroscope, shows a continuous spectrum through the red, yellow and green with a trace of blue. Phosphorescence is suggested, possibly similar to that shown by alum.

May I lay this before your readers in the hope that some one of them may be familiar with, and have an explanation for, this luminosity. Our time at present is so taken up with other matters that investigation of it can not be pushed as would otherwise be the case.

Harvey B. Lemon
Ryerson Physical Laboratory,
University of Chicago

AN UNUSUALLY BRILLIANT HALO

To the Editor of Science: The very complete halos visible at Boulder, Colo., on the morning of January 10, 1918, are perhaps worthy of a brief description

The phenomena were first observed when the sun was about 10° or 12° high. At this time all of the 22° halo that was above the horizon was very distinct. The white horizontal parhelic circle extending each way from the sun to a short distance outside the 22° halo was also plainly marked and the parhelia where it crossed the halo were very bright, though somewhat diffuse. In about half an hour the 22° halo became much brighter showing red on the inside and a faint blue on the outside. Above the sun, tangent to this halo and convex toward the sun, appeared the usual ox-yoke-shaped arc of a pale pink tinge. During this time also the 46° halo appeared and be-

came very bright and complete except for the portion below the horizon. It clearly showed red on the inside and blue on the outside. Tangent to this halo, directly above the sun and convex toward it, was a strongly colored arc of a circle, red on the convex and blue on the concave side.

As the sun's altitude increased the parhelic circle gradually extended until it reached nearly around the horizon and the paranthelia 120° from the sun had become very distinct patches of white light. The 22° parhelia meanwhile had become dazzlingly bright, considerably elongated perpendicularly, and showed orange red on the side farthest from the sun. This color arrangement being the reverse of that of the 22° halo seems peculiar.

The phenomena remained visible until about eleven o'clock before which time the 22° halo appeared as a complete circle above the horizon and the parhelion directly below the sun showed brightly. Before vanishing the bright 46° halo and its brilliantly colored tangent arc appeared almost at the zenith.

Measurements of the diameters of the halos and the angular positions of the parhelia were made with an improvised transit. No claim to accuracy can be made for them, both because of the apparatus and because of the bright and diffuse nature of the objects, but the results obtained are practically those given above as was to be expected.

The temperature during the night had been below zero and in the morning was still 3° or 4° below it. The air was quiet and filled with falling crystals of ice.

O. C. Lester

University of Colorado

MARKING MICROSCOPE SLIDES

In the issue of Science for January 4, Mr. P. A. West gives an aluminum clip method for labelling glass slides while staining which he finds more satisfactory than the diamond pencil or the water-proof-ink method.

With me his objection to a label scratched on the glass does not hold, as I use a jar in which the upper end of the slide is not covered by the stain. I have for several years used an improvised carborundum pencil and have found it most satisfactory.

A fair-sized crystal of carborundum, chosen for one or more sharp points is laid between the two halves of a firm piece of elder pith about an inch and a half long, with the sharp end projecting only sufficiently to make its use easy. Rubber bands are then wound tightly about both ends of the pith, holding the carborundum firmly in place. The pencil may be pointed up by trimming the edges of the pith around the crystal. This pencil is more easily handled than the bare crystal and scratches the data quickly and easily on the slides.

Mary K. Bryan

Department of Agriculture

SCIENTIFIC BOOKS

The Organization of Thought. By A. N. Whitehead, Sc.D., F.R.S., Fellow of Trinity College, Cambridge, and Professor of Applied Mathematics at the Imperial College of Science and Technology. London, Williams and Norgate. 1917. Pp. 219.

This volume is a collection of eight discourses bearing the following titles:

I. The Aims of Education—A Plea for Reform.
II. Technical Education and Its Relation to Science and Literature.
III. A Polytechnic in War-time.
IV. The Mathematical Curriculum.
V. The Principles of Mathematics in Relation to Elementary Teaching.
VI. The Organization of Thought.
VII. The Anatomy of Some Scientific Ideas.
VIII. Space, Time and Relativity.

Except number VII., which is here published for the first time, the articles are addresses delivered before various scientific associations in course of the last four years. The range of discussion is wide, even wider than the diversity of titles might lead one to expect; yet the discussions have a deep unity in the fact that they deal with various aspects of one great matter, the organization of thought, and so the book is happily named. Fresh, direct, trenchant, vital and swift, the style is such as to give the reader more energy

than the reading demands of him, though this demand is not slight.

For whom is the book designed? Those whose acquaintance with Professor Whitehead is confined to his authorship of the "Universal Algebra" and to his joint authorship (with Mr. Bertrand Russell) of the "Principia Mathematica" will be disposed to assume that the present book is designed solely for students of modern logic and the foundations of mathematics. But that assumption would be false. The questions dealt with are large questions of education and of science, and the author is deep enough and circumspect enough to know that no really large question can be merely logical or mathematical or physical or narrowly scientific or philosophical. Accordingly the discussions, while they are of great interest to logicians and mathematicians, are or ought to be of equal interest to psychologists, educators and almost every other type of student and thinker.

The fact just mentioned is strikingly illustrated and confirmed in the final chapter where in dealing with the nature and meaning of time, space and relativity, a first deliberate attempt is made to recognize all the possible ways of approach and to bring into relation with one another the method of the experimental physicist, the method of the mathematical physicist, the method of the experimental psychologist, the method of the metaphysician and the postulational method of the mathematician.

A like commendable catholicity pervades the very suggestive chapter dealing with the anatomy of scientific ideas. This chapter ought to be read in connection with Russell's "Scientific Method in Philosophy." The aim of the two is the same. It is to show a method of *constructing* the fundamental conceptual things—points, atoms, electrons, molecules, etc.—of mathematics and physics (indeed of science in general) out of sense-given data so that we shall not have to be content with *inferring* the existance of such conceptual things but shall *know* their existence as deliberate constructs of our own. Space is lacking to indicate the method here and I must content myself with saying that philosophers, psychologists, logicians and students of natural science, if they do not read the discussion, will miss a great treat.

The title-giving essay, which treats of the organization of thought, is concerned with the relation of logic to science. A thoughtful reading of it will amply repay any one for the trouble, though its full significance can not be appreciated by such as are not acquainted with modern developments in logical theory and especially with its culmination in the above-mentioned "Principia Mathematica." Any reader of SCIENCE who happens to know that the author's knowledge of logic has probably never been surpassed will think twice before turning from the following profound and brilliant words closing the chapter in question: "Neither logic without observation, nor observation without logic, can move one step in the formation of science. We may conceive humanity as engaged in an internecine conflict between youth and age. Youth is not defined by years, but by the creative impulse to make something. The aged are those who, before all things, desire not to make a mistake. Logic is the olive branch from the old to the young, the wand which in the hands of youth has the magic property of creating science."

The other essays are concerned primarily with education, secondarily with science. The point of view is fairly well disclosed by a few brief deliverances. "There is only one subject-matter for education, and that is life in all its manifestations." Again: "The devil in the scholastic world has assumed the form of a general education consisting of scraps of a large number of disconnected subjects." What is the cultural value of such scraps? Answer: "A merely well-informed man is the most useless bore on God's earth." What is the right attitude of education towards past, present and future? "No more deadly harm can be done to young minds than by depreciation of the present. The present contains all that there is. It is holy ground; for it is the past and it is the future." Why teach children to solve quadratic equations? "Quadratic equations are part of algebra, and alge-

bra is the intellectual instrument which has been created for rendering clear the quantitative aspects of the world." But are these aspects important? "Through and through the world is infected with quantity. To talk sense is to talk in quantities. It is no use saying that the nation is large,—How large? It is no use saying that radium is scarce,—How scarce? You can not evade quantity. You may fly to poetry and to music, and quantity and number will face you in your rythms and your octaves."

What artist or man of letters has spoken deeper and truer words than the following words spoken by a logician and mathematician regarding style as an aim and test of education? "Finally there should grow the most austere of all mental qualities; I mean the sense for style. It is an esthetic sense based on admiration for the direct attainment of a foreseen end, simply and without waste. Style in art, style in literature, style in science, style in logic, style in practical execution have fundamentally the same esthetic qualities, namely, attainment and restraint. The love of a subject in itself and for itself, where it is not the sleepy pleasure of pacing a mental quarter-deck, is the love of style as manifested in that study. Here we are brought back to the position from which we started, the utility of education. Style, in its finest sense, is the last acquirement of the educated mind; it is also the most useful. It pervades the whole being. The administrator with a sense for style hates waste; the engineer with a sense for style economizes his material; the artisan with a sense for style prefers good work. Style is the ultimate morality of mind. But above style, and above knowledge, there is something, a vague shape like fate above the Greek gods. That something is Power. Style is the fashioning of power, the restraining of power. . . . It is the peculiar contribution of specialism to culture."

Never before have I been tempted in reviewing a book to quote so many of the author's words. I have felt that Whitehead must be allowed to speak for himself. The foregoing quotations are but samples of his manner in dealing with other great questions of science and education. It is my hope that the samples may induce readers of SCIENCE to read the book.

C. J. KEYSER
COLUMBIA UNIVERSITY

SPECIAL ARTICLES

A PRELIMINARY NOTE ON SOIL MOISTURE AND TEMPERATURE FACTORS IN THE WINTER-KILLING OF GRAIN CROPS

FEW investigations show the relation of kind of soil and moisture to temperature during the winter while none deal with their relation to the winter survival of crop plants. Winter-killing and spring condition of alfalfa, clover, winter wheat, oats, rye, barley, and other crops are very largely dependent on soil temperature during the winter months. These factors have been studied at the Kansas Experiment Station in connection with a general study of the causes of winter-killing of cereal crops.

In the fall of 1914 records were taken of the temperature in three plots of silt loam, to each of which different quantities of water were added during the fall and winter, and on which winter wheat, winter barley, and winter oats were grown. In the fall of 1915 three plots of heavy clay and two of sand were included, there being added to each plot different quantities of water as before. The temperature was recorded at a depth of one inch, three inches and six inches by means of standardized toluol thermometers during the first season, while electric thermometers were used the second. There was no heaving of the soil in either season and the survival of the plants appeared to depend on temperature alone.

The interrelation between the factors studied is very complex, the net resultant varying widely with the degree of variation of the single factors, and also with the character of the season, especially the degree of cold; the duration of freezing weather; the rate of change of air temperature; and the amount of snow. In the first season the lowest temperatures were recorded on the dry plot and the survival of the barley and oats was decidedly less than for the medium wet or the wet plots. The wheat survived practically

alike on all plots, there being very little injury to this cereal. Directly contrary results were obtained the second season, the temperature being lowest and the survival least on the wet plots.

This apparent anomaly seems to have been due to the character of the seasons and the changes in specific heat and thermal conductivity that takes place when water changes to ice. The first winter was comparatively mild and snow covered the plots during the coldest weather to a depth of several inches. As a result the soil was never frozen more than a few inches deep or for more than a few days at a time. Consequently, the changes in temperature were much less rapid on the wet than on the dry plot because of the specific heat and the latent heat of fusion of the water. The temperature of the wet plot was therefore more uniform, the highest daily maxima and minima being recorded for the dry plot.

The second winter was colder, and since the plots were not protected with snow they were frozen most of the time. The relationship between the wet and dry soil that was maintained during the first season was directly reversed, the lowest daily minima and the least survival being recorded on the wet soil. This reversal was apparently due to the difference in specific heat and the thermal conductivity of ice and water. When water freezes the specific heat is reduced approximately one half while the thermal conductivity is increased more than three times.[1] Consequently the difference in apparent specific heat of a wet and a dry soil is much less when it is frozen than when unfrozen, while the difference in thermal conductivity is greatly increased. The increase in the latter is sufficient to overbalance the difference in apparent specific heat permitting the temperature fluctuations of the air to be more quickly recorded in the soil.

The wet and dry clay plots exhibited the same relation between moisture content, temperature and winter-killing that was found for the silt loam, only in greater degree. For example, 81.7 per cent. of the wheat and 11.7 per cent. of the barley survived on the dry silt loam as compared with 52.5 per cent. and 7.2 per cent. for the wheat and barley, respectively, on the wet silt loam, or a difference in favor of the dry soil of 29.5 per cent. for the wheat and 4.5 per cent. for the barley. On the clay, 89.4 per cent. of the wheat and 58.8 per cent. of the barley survived on the dry plot as compared with 20.4 per cent. and 2.1 per cent. for the wheat and barley, respectively, on the wet plot, or a difference of 69.0 per cent. for the wheat and 18.3 per cent. for the barley. The difference in temperature between wet and dry plots was also greater on the clay than on the silt loam.

[1] Reed and Guthe, Macmillan Co., 1914.

On the sandy plots the effect of moisture on temperature and winter-killing was contrary to its effect on clay or silt loam when the soil was frozen, but corresponded qualitatively with the latter types when they were not frozen. The temperature of the dry sand was lower during the winter and the survival less than for the wet sand, freezing apparently having little influence. This was probably due to the fact that sand is a much better conductor of heat than other soils and hence there is less difference in the thermal conductivity of wet and dry sand than for soils of the heavier types. Also the water capacity of sand is much less than that of other soils, and there is consequently less change in the thermal conductivity when it is frozen.

Further data may permit prediction on the relative survival of grain crops on soils of different type and moisture content. The preliminary work indicates that a sandy soil is colder and the survival of plants growing upon it less than on a dry clay or loam soil, and also colder than a wet clay or a wet loam during those seasons when the ground remains unfrozen much of the time. It appears probable that dry sand is colder during the winter than a wet sand regardless of the character of the season, but a dry clay or silt loam is colder than a wet soil of the same kind, only when the ground remains unfrozen.

S. C. Salmon

Kansas State Agricultural College,
Manhattan, Kans.

SCIENCE

FRIDAY, FEBRUARY 22, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE RED CROSS AND THE ANTIVIVISECTIONISTS:

AN APPEAL TO THE FAMILIES AND FRIENDS OF OUR HEROIC TROOPS AND TO THE COMMON SENSE OF THE AMERICAN PEOPLE

FIRST of all let me make two facts clear.

1. This paper has been written entirely on my own responsibility and not at the suggestion directly or indirectly of the Red Cross. I have been moved to write it solely in the interest of our brave soldiers, and especially because their sufferings and lives are involved in the suit against the Red Cross by the antivivisectionists to prevent the use of $100,000 of the Red Cross funds in such beneficent life-saving researches.

2. The Red Cross as an organization is neither an opponent, nor an advocate, nor a defender, of vivisection. It states officially that the *supreme* aim of the Red Cross is to *relieve human suffering* [and it might well have added "and to save thousands of human lives"].

> The War Council was advised from the ablest sources available that an immediate appropriation for medical research would contribute to that end. The War Council could not disregard such advice.

They then refer to the many unsolved medical and surgical problems that have arisen from wholly new conditions and methods of warfare. Letters from a number of my own surgical friends in France emphasize and the medical journals teem with papers on these new problems. They relate to the treatment of the horribly infected wounds—and practically *all* wounds are of this kind—never met with in civil surgery; to the treatment of "trench

fever"—a peculiar form of fever never before seen; of "trench heart"; of "trench foot," often followed by lockjaw; of "trench nephritis" (inflammation of the kidneys); gas gangrene; tetanus; shell shock; poisonous gases; fearful compound fractures, especially of the thigh, etc. Every man enabled to return to active duty as a result of solving these problems helps to win the war. Every man who dies, or is permanently disabled because of our ignorance, hinders our winning the war.

It must be remembered that our surgeons, physicians and physiologists over there are the very flower of the American medical profession. These fine men under the supervision of the Medical Staff of the United States Army, superintend all the work. Nothing is done that has not the direct approval of Brigadier General A. E. Bradley, U. S. Army.

Experiments on animals form a necessary but a minor feature of the researches.

The animals used are principally guinea-pigs, rabbits and white rats. If operations causing pain to animals are performed, anesthesia is used.

This certainly does not suggest "cruelty" or "torture."

I appeal to the common sense of the American people and especially to the families and friends of our brave soldier boys: Which do you prefer (1) That our soldiers shall be protected from attacks of these new (as well as of the familiar) diseases, their sufferings lessened or even prevented, and their lives saved, or (2) will you insist that not a single guinea-pig, rabbit or rat shall suffer the slightest pain or lose its life, in researches to lessen the suffering and save the lives of our soldiers?

Remember, if you choose the second you deliberately condemn your son, brother, or husband to sufferings far beyond any suffering of these animals. In many cases, as I shall show, you will condemn your dear one to death, and in some cases a horribly painful death.

In the "Bill of Complaint" of the Antivivisectionists, seven grounds of opposition to vivisection are mentioned. The sixth reads as follows:

That although it [vivisection] has been practised for many years, *nothing has been discovered by means of it that is at all beneficial to the human race.*

This is the crux of the whole matter. If this were true I would vigorously oppose vivisection myself.

I entered upon my medical studies in 1860. I took part in the horrible surgery of the Civil War—as we now know it was. I have taught anatomy and surgery to not far from 10,000 students. I taught and practised the old dirty surgery—the only kind we then had—up to October 1, 1876. Since that date I have practised and taught the new antiseptic surgery, which has been created by researches similar to those now proposed. Since the great war began I have diligently studied the newest surgery. I submit, therefore, that I may be presumed to be fairly familiar with these three stages of surgery. Let me give now a few examples of some of the things that HAVE "been discovered by it [vivisection]" and that "*are* beneficial to the human race."

I may remark in passing that animals themselves have benefited by the same means, almost, and possibly quite as much as the human race.

1. *Typhoid Fever.*—This has been one of the historic scourage of armies. In 1880 the bacillus—the cause of the fever—was discovered. It was soon proved that the disease was spread through infected milk, infected water, and very largely by the house-fly. The last, after walking over the excrement of a typhoid patient, and then walking over our food, conveyed the dis-

ease. Prevention of contamination by these three means—sanitary measures based on the discoveries of bacteriology prevent the disease to a large extent. But our real triumph over the disease was not achieved until lately.

I may here call attention to the fact that the antivivisectionists entirely reject bacteriology, a science which has disclosed to us the causes of many diseases, and has enabled us to prepare antitoxins to neutralize the poisons developed by these bacteria. Without bacteriology the physician and the surgeon to-day would be as helpless as a mariner without a compass.

	Cases		Deaths
During the Civil War typhoid fever resulted in..........	79,462	and	29,336
In the Boer War there were..	58,000	"	8,000
(In that war the total number of deaths was 22,000. Typhoid alone, therefore, was responsible for more than one third of all the deaths!)			
In our war with Spain there were	20,738	"	1,580
Our Army numbered 107,973 men. Therefore every fifth soldier fell ill with typhoid in 1898! Over 86 per cent. of *all* deaths in this war were due to typhoid!!			

During the Boer War imperfect attempts were made to control typhoid by an antitoxin similar to that against diphtheria, which has saved such multitudes of children. Gradually the method has been improved so that in our army it was at first recommended as a voluntary protection (1909). The results were so favorable that in 1911 it was made compulsory. It has been said that it should still be voluntary. But as every case of typhoid imperils the health and life of multitudes we surely have a right to make it compulsory so as to protect all the rest. All that is necessary to prove this is to look at these tables of cases and deaths in our Army and Navy.

TYPHOID FEVER IN THE UNITED STATES ARMY

Year	Cases	Deaths
1906	210	12
1907	124	7
1908	136	11
1909	173	16

ANTI-TYPHOID VACCINATION MADE COMPULSORY

Year	Cases	Deaths
1911	70	8
1912	27	4
1913	4	0
1914	7	3
1915	8[1]	0

TYPHOID FEVER IN THE UNITED STATES NAVY

Year	Cases	Deaths
1909	189	17
1910	193	10
1911	222	15

ANTI-TYPHOID VACCINATION MADE COMPULSORY

Year	Cases	Deaths
1912	57	2
1913	22	4
1914	13	0
1915	15	1

On the Mexican border, though the fever was rife near the camps, only *one man* out of 20,000 troops, a civilian, who unfortunately escaped vaccination, fell ill with it.

Now let us see the results in the armies in the present war.

In the British armies, on March 1, 1917, Mr. Forster, Under Secretary for War, stated in the House of Commons that

> The last weekly returns showed only twenty-four cases in the four British armies in France, Salonica, Egypt and Mesopotamia. He added that the total number of cases of typhoid fever in the British troops in France down to November 1, 1916, was 1,684, of para-typhoid,[2] 2,534, and of indefinite cases, 353, making a total of 4,571 of the typhoid group.

Now the English armies number at least 5,000,000. If they had suffered as our

[1] Four in the United States; 4 in Hawaii.

[2] A form of fever caused by a bacillus somewhat similar to the typhoid bacillus but causing a much milder infection.

Army did in 1898 there would have been 1,000,000 cases! In fact there have been less than 4,600! Besides that, the percentage of fatal cases in the inoculated men was 4.7 per cent., in the uninoculated 23.5 per cent.; and perforation of the bowel, the most dangerous complication, occurred *six times more frequently* among the unvaccinated than among those who had been protected. In the British armies the antityphoid vaccination is still voluntary but over 90 per cent. are thus protected. If it had been compulsory, hundreds of the 4,571 *who died would have been saved!*

In our own army in over four months (September 21, 1917, to January 25, 1918) a period one month longer than our war with Spain (the Surgeon General's Office gives me the official figures), we have had an average (*i. e.*, every day of these four months), of 742,626 men in our cantonments and camps. These men have come from all over the country, in many cases from where autumnal typhoid was reaping its annual harvest, in practically all cases unprotected by the vaccination. Between these two dates there have been 114 cases of typhoid and 5 of paratyphoid. *Had the conditions of 1898 prevailed there would have been 144,506 cases instead of 119 in all!* The reason is clear. The men were all immediately vaccinated against typhoid, paratyphoid and smallpox.[8]

Besides this as soon as the antityphoid inoculation was completed the number of cases rapidly fell and from December 14 to January 25—6 weeks!—there have been only 6 cases of typhoid and one of paratyphoid among probably now nearly 1,000,000 men! Truly marvellous!

Now all this is the *direct result of bacteriological laboratory work.* Was it not worth while? Has it not "benefitted the human race"? Are you not glad that *your* son is thus protected?

[8] Of the latter disease there have been only 4 cases, all unvaccinated.

I may add that the German armies show a similar absence of typhoid. I have seen no figures but only general statements.

Tetanus or "Lock-jaw."—Few people realize what terrible suffering this disease causes. The mind of the patient is perfectly clear, usually to the very end, so that his sufferings are felt in their full intensity. All of my readers have had severe cramps in the sole of the foot or calf of the leg. The pain is sometimes almost "unbearable." In tetanus not the muscles of the jaw alone are thus gripped, but the muscles all over the body are in cramps ten or twenty fold more severe, cramps so horrible that in the worst cases the muscles of the trunk arch the body like a bridge and only the heels and the head touch the bed!

Never shall I forget a fine young soldier during the Civil War who soon after Gettysburg manifested the disease in all its dreadful horror. His body was arched as I have described it. When at intervals he lay relaxed, a heavy footstep in the ward, or the bang of a door, would instantly cause the most frightful spasms all over his now bowed body and he hissed his pitiful groans between tightly clenched teeth. The ward was emptied, a half-moon pad was hung between the two doorknobs to prevent any banging; even the sentry, pacing his monotonous steps just outside the ward, had to be removed beyond earshot. . . . The spasms became more and more severe, the intervals shorter and shorter; it did not need even a footfall now to produce the spontaneous cramps, until finally a cruelly merciful attack seized upon the muscles of his throat and then his body was relaxed once more and forever. He had been choked to death.

Do you wonder at the joy unspeakable which we surgeons have felt of late years as we have conquered this fearful dragon? In 1884 the peculiar germ, shaped like a miniature drum-stick, was discovered. Its home is in the intestines of animals, especially of horses. The soil of France and

Belgium has been roamed over by animals and manured for over 2,000 years, even before Julius Cæsar conquered and praised the Belgians. The men in the trenches and their clothing are besmeared and bemired with this soil, rich in all kinds of bacteria, including those of tetanus, gas gangrene, etc. When the flesh is torn open by a shell, ragged bits of the muddy clothing or other similarly infected foreign bodies are usually driven into the depths of the wound. Now the tetanus bacilli and the bacilli of "gas-gangrene" are the most virulent of all germs. It takes 225,000,000 of the ordinary pus-producing germs to cause an abscess and 1,000,000,000 to kill, while 1,000 tetanus bacilli are enough to kill. This readily explains the frightful mortality of tetanus during the Civil War. It killed 90 patients out of every hundred attacked.

In the early months of the Great War the armies suddenly placed in the field were so huge that there was not a sufficient supply of the antitoxin of tetanus. Hence a very considerable number of cases of tetanus appeared. Now it is very different. At present every wounded soldier, the moment he reaches a surgeon is given a dose of antitetanic serum. As a result, *tetanus has been almost wiped off the slate.* I say "almost," because to be effective the serum must be given within a few hours. The poor fellows who lie for hours and even days in No Man's Land can not be reached till too late. All the surgeons on both sides concur in saying that tetanus, while it still occurs here and there, has been practically *conquered.*

Every step of this work has been accomplished by the bacteriologists and the surgeons working together in the laboratory and the hospital.

Would you seriously advise that no such experimental researches should have been carried on and that your boy should suffer the horrible fate of my own poor Gettysburg boy? Confess honestly, are not these and other similar researches to be described as humane?—as desirable?—nay, as imperative?

But the antivivisectionists declare that bacteriology is false—that such vaccination is "filling the veins with 'scientific filth' called serum or vaccine"! They are doing their best to persuade our soldiers not to submit to any such "vaccination"!

Nay, more "we feel," say forty-one of our medical officers on duty in France, "that any one endeavoring to stop the Red Cross from assisting in its humanitarian and humane desire to prevent American soldiers from being diseased, and protecting them by solving the peculiar new problems of disease with which the Army is confronted *is in reality giving aid and comfort to the enemy.*"

Small-pox.—The word vaccination leads me to say a word about small-pox. I confess that I *was* amused by a recent paper in an antivivisection journal entitled "Vaccination as a *Cause* of Small-pox"! During the last year hundreds of thousands of soldiers have been vaccinated against small-pox. Surely there should have been *some* cases of that disgusting disease if it were caused by vaccination.

But what are the facts? I have just received the Report of Surgeon General Gorgas for 1917. The section on Small-pox reminds one of the celebrated chapter on "Snakes in Ireland." On p. 81 on Small-pox in the Army in the United States, I read "*No* cases of small-pox occurred within the United States proper during the year." On p. 175, I read "*No* cases [of small-pox or varioloid] occurred in the islands" [among the American troops in the Philippines]. On p. 188, I read under Small-pox that "nine cases occurred

during the year" [among the Philippine Scouts].

My friend and former student, Dr. Victor G. Heiser, as director of health in the Philippine Islands for years, vaccinated over 8,000,000 persons without a death—and with what result? In and around Manila the usual toll of small-pox had been 6,000 deaths and about 25,000 cases annually. In the twelve months after his vaccination campaign was finished there was *not one death* from small-pox.

Per contra, in 1885 in Montreal, as stated by Osler, one Pullman porter introduced small-pox into a largely *un*vaccinated city. There followed 3,164 deaths and enormous losses to the Montreal merchants.

But why say more? We all know that a single case in any community causes every intelligent person to be protected by vaccination.

Gas-Gangrene.—One of the terrible and new surgical diseases developed by this war is called "gasgangrene." It has no relation to the poisonous gases introduced by the barbarous Germans at Ypres. About twenty-five years ago Professor W. H. Welch, of the Johns Hopkins Hospital, discovered a bacterium which *produced gas* in the interstices between and in the muscles. This bacillus does not occur in Great Britain. I never saw a case of gasgangrene in the Civil War, and but one case since then in civil practise. On the contrary in Belgium and France in the soil and, therefore, on the clothing and on the skin of the soldiers these bacilli abound. From what Bashford calls the "cess-pool of the wound" the germs travel up and down in the axis of the limb. If it escapes from a puncture it will take fire from a match. Gas has been observed within five hours. An entire limb may become gangrenous within sixteen hours. If the whole limb is amputated the gas may be so abundant that the limb will float in water! Death is not long delayed.

Now your son in France runs a very serious risk of becoming infected with this deadly germ. Would you be willing positively to forbid any experiments on animals which could teach us how to recognize this infection as early as possible? Would you forbid any experiments which might teach us how to *conquer* or better still to *prevent* this virulent infection and save his life? Which would you prefer should suffer and very possibly die, a few minor animals or your own son? If a horse or a dog or even a tiny mouse can help in this sacred crusade for liberty and civilization, if it even suffers and dies, is it not a worthy sacrifice? Should they be spared and our own kith and kin give up their lives?

I need not wait for a reply! I am sure you would say "My boy is worth 10,000 rabbits or guinea-pigs or rats! Go on! Hurry, hurry! and find the remedy." That is *true* humanity which will save human lives even at the expense of some animals' lives.

Now see the result. By careful observation and experiments with different remedies the surgeons have discovered valuable methods of treatment. But very many still die. *Prevention* is always far better than cure. At the Rockefeller Institute Drs. Bull and Ida W. Pritchett have discovered a serum which in animals *prevents* this gasgangrene and yet does no harm to the animal. It is now being tried on the soldiers in France.

Again I ask: Is it not our duty even to *insist* on such experiments so that our troops may be spared the dreadful suffering and even death following this virulent infection? If the Bull-Pritchett serum proves ineffective should not our efforts be redoubled? The common sense of the

American people will reply: "Yes, by all means. You will be recreant to humanity and to your duty if you do not."

Modern Surgery.—"Lister," in Howard Marsh's fine phrase "opened the gates of mercy to mankind." Pasteur and Lister are the two greatest benefactors of the human race in the domain of medicine. I am not sure but that I might even omit the last five words.

The *revolution* which Lister produced in surgery is so well known to every intelligent person that I need only say a few words. Forty years ago a wholly new surgical era was inaugurated by Pasteur and Lister. In the Civil War there were recorded 64 wounds of the stomach and only *one* recovered. Otis estimated the mortality at 99 per cent. In over 650 cases of wounds of the intestines there were only five cases of recovery after wounds of the small bowel and 59 from wounds of the large bowel—together only 64 out of 650 recovered, *i. e.*, over 90 out of every 100 died!

The complete statistics of the present war can not be tabulated and published for some years. I give, however, the result of one series of abdominal gunshot wounds as a contrast, on a far larger scale and in far worse wounds. Out of 500 such operations, 245 *recovered!* and only 255 died! Contrast 51 per cent. of deaths in these wounds with mutilation and infection unutterably worse than in the Civil War, with 99 per cent. of deaths, according to Otis.

Is not this a triumph of bacteriological and surgical research? Would you prohibit similar researches now when your boy's life may be saved by them?

Is not this one of the things that *have "been discovered"* by vivisection and has not such change in surgical treatment been of "*benefit* to the human race"? In all honesty would you be willing to have your son treated as I myself (may God forgive me!) ignorantly treated hundreds during the Civil War?

This advance I do not *think* or BELIEVE, but I KNOW is due to Pasteur and Lister and their followers. I know it by personal experience just as you know the high cost of living, the shortage of sugar and the scarcity of coal.

The bacteriology which the antivivisectionists scorn and reject I KNOW is the CORNERSTONE of modern surgery. Before Lister's day out of 100 cases of compound fracture 66 died from infection. Now *less than one* out of 100 die. Before Lister my old master in surgery, Dr. Washington L. Atlee, one of the pioneers in practising ovariotomy, lost two out of every 3 patients—now only two or three in a hundred die. Before Lister we never *dared* to open the head, the chest or the abdomen unless they were already opened by the knife, the bullet or other wounding body. Now we open all of these great cavities freely and do operations of which the great surgeons of the past never dreamed in the wildest flights of their imagination. Could they return to earth they would think us stark crazy until they found that the mortailty was almost negligible and the lives saved numbered hundreds of thousands.

I have given but a few instances of the many wonderful benefits which have resulted from medical research in every department of medicine. But I believe they are sufficiently convincing. I can sympathize with the deep feelings of those who wish to spare pain to animals, but is it not a higher and more imperative, a holier sympathy that has spared and will spare pain eventually to human beings and also to other animals in uncounted numbers?

Do you wonder that after over forty years of steady practise, teaching and writing I assert, conscious of the great responsi-

bility of my words, that "I regard experimental research in medicine as a medical, a moral and a Christian *duty* towards animals, towards my fellow men and towards God."

There is so much yet to be learned chiefly, by experimental research. So many devoted lives to be saved to our country and to mankind if we only knew how! Do you wonder that I am in dead earnest?

Finally. What have the antivivisectionists themselves done to diminish sickness and save life?

A. In animals? Absolutely nothing.

In spite of the enormous ravages of animal diseases causing enormous suffering to animals and costing this country $215,000,000 every year, not a single disease has had its ravages diminished or abolished as a result of anything *they* have done. But medical research is saving every year thousands of animals from anthrax, hog cholera, chicken cholera, Texas fever and other diseases.

B. In human beings? Absolutely nothing. I do not know a single disease of human beings which has had its ravages checked, abated or abolished by any work ever done by the antivivisectionists.

The only thing they *have* done has been to throw as many obstacles as possible in the path of those who are striving to benefit both animals and men.

This present suit is characteristic.

W. W. Keen

Emeritus Professor of Surgery,
Jefferson Medical College and
Major in the Medical Reserve Corps,
U. S. Army

SOME OPINIONS ON COLLEGE PHYSICS TEACHING

Originally the whole of science, physics has come by specialization to have for a central interest the relations of energy to matter, motion, heat and electricity; it lies, not sharply bounded, among astronomy, chemistry, the biological and earth sciences, and their applications in engineering and agriculture. From it all these draw fundamental data, and from it new branches continually develop. The history of this development is very interesting and instructive; it forms one phase of the intellectual development of humanity, and should be known to all students whose interests are at all higher than the bread-and-butter level.

It has been said that science is common sense. That is incompletely true; for *common* sense results from *common* experience, and can hardly deal with uncommon or new situations. From this arises one of the difficulties which to many people make physics a repulsive subject. It deals with facts of all sorts, from bearing friction and the flow of water in pipes to the flight of wireless waves and the rotation of nebulæ, and has to adopt a viewpoint which can not be that of common experience; for observations on most of this vast range are not commonly made, and not by common people. Newton's three laws of motion, for example, are not expressions of common sense; otherwise they would not have been reserved for Newton to state. They are known not to be in conflict with common experience; they include it; but the average person has not had the uncommon astronomical and laboratory experiences necessary for their discovery or appreciation. Hence the mechanics based on them seems stale and dry, metaphysical, out of connection with experience.

The subject of physics being thus vast, not clearly defined and to a certain extent removed from common experience, only a part of it can be taught in elementary courses. What this part shall be has to be decided with an eye on two things; it must seem worth while to the student, and it must expand his horizon of experience, so that the great general laws which have been discovered shall seem to him to spring naturally from the behavior of matter. To seem worth while to a student, the subject-matter of a course must build upon what he already knows, and must have evident bearing upon the problems which he knows he will have to solve. He has had experience with crow-

bars, boats, automobiles, telephones; it is wise to start out with this knowledge and unify it; he knows he must solve problems in practise, with pulleys, hydraulic rams, cameras or wireless instruments; he should see that his physics is leading to an ability to do these things.

In mass teaching, such as teaching in most American institutions must be, the aim of the teacher must be at the average man in the class. The ground covered, the rate at which it is covered, and its relative difficulty, must depend on the ambitions of this average man; these can be determined only by "feeling of" the class, and change from year to year. While this matter is one too extensive for treatment here, it should be noted that the problem is by no means a simple one; the teacher is only one element in the competition of which the student is the center, and he and his course can not always hope to master the student's attention against the intense pressure of fraternities, games, "Wein, Weiber und Gesang." To play a part in this competition and win any real success implies that the teacher must realize the situation and be ready himself to exert a sensible pressure. The easy-going notion that they may take it or leave it—that's their business—is as much out of place in the teaching of physics as it is in the selling of hair-wash and automobiles. I believe that college administrations are more at fault in their ill appreciation of this than are college teachers, though something can be said on both sides.

The teaching methods usually adopted for elementary work are lectures, text-book study with problem-solving, and laboratory work. Each has its peculiarities, its limitations and difficulties.

Physics lectures are carried on with experiments, qualitative or semi-quantitative, which the audience observes under the guidance of the speaker, without having to supply skill or initiative. This method is the only one for the exposition of original research or recent progress; many experiments are valuable when taken up thus and less so otherwise; the more or less passive attitude of the audience is the great weakness. It does very well as an easy way for beginning or general classes; pedagogical tricks, like written notes and quizzes, help to diminish somewhat the somnolence due to passivity. However, every lecture is probably more valuable to the speaker than to any of his hearers. Every teacher who uses this method, and requires the completion of written notebooks on the course, should read some of these notebooks with some care. He will learn something about the value to the audience of his own lectures.

The presentation of lecture experiments is often weakened by inattention to the details of lighting. An experiment which only a few of the audience can see is wasted, however it may please the lecturer, for it is his business to "get it over" just as much as if there were footlights between him and his hearers. It is not enough to set the apparatus up—it must go; and it is not enough that the experiment go—the audience must see it; and weak lighting of the critical point, glitter and glare on glass surfaces, supports in the way, etc., sometimes hinder the audience from seeing. While the experiment is being tried out in advance the lecturer should view it from the audience space and from the most disadvantageous points, to correct such weaknesses.

The combined recitation and laboratory method makes greater demands on the members of a class than the lecture method. I do not believe that any student should be allowed to take a purely text-book course in elementary physics; the laboratory should invariably accompany the recitation.

The study of a book, the solution of problems, the answering of questions, give play to both originality and skill; book explanations and descriptions of experiments not only lead to an understanding of work performed in the laboratory, but they bring in order before the mind the results of experiments and observations which only a favored few can ever directly know because of difficulty, expense or length of time required.

The objects of laboratory work are two; to illustrate (not demonstrate) the laws of nature, and to teach the technique of experiment. This latter is apparently only secondary, but

without it experiments illustrate rather the fallibility of human nature than the laws of nature. Much time and effort must be given to it. It was formerly a common notion that in the laboratory the student should by himself rediscover the laws of nature, doing in a few youthful work periods what during two thousand years the greatest minds only gradually accomplished. Nobody thinks of that *now*; the laws of machines, of motion, of heat and electricity can only be illustrated, not discovered, in the student laboratory. The beginner has not only to make the illustrative observations, he must *learn how* to make them. The technique of observation is as real as that of the shop; just as in wood shop or forge or machine room the ways of handling materials and metals which experience has proved good are not only taught but insisted on, so the technique of the laboratory must be enforced; the setting up of apparatus, the making of measurements, the interpretation of the measurements, all these must be done according to good ways developed by experience. Hence there must be rather explicit directions for work placed in the hands of the student, dealing not merely with apparatus in general, but with the apparatus of the laboratory where the work is done. It is justly to be questioned whether general laboratory manuals are a success; were all laboratories equipped with the same patterns of apparatus it might be possible to write a manual which would serve them all; as the case is, different laboratories have such different equipments, inherited and constructed, that the detailed directions which the beginner must have are unique in each institution. This does not mean, of course, that manuals can not be written in book form (though I hold the loose-leaf system better, as more flexible), but that the book which fits the conditions of one place can hardly fit those of another.

Not only is the technique of observation the result of a long historical development; equally so is the technique of the interpretation of observations when made. For the elementary laboratory the experiment directions should be laid out with this in mind, and good methods of reduction and a reasonable standard of accuracy insisted on. Of course the degree of accuracy can not be very high—usually a tenth of a per cent. is very good for student work, and sufficient, in well-planned experiments, for the illustrations desired. Better than this is hardly to be expected, as the apparatus for beginners can not have many refinements, and must also be fairly fool-proof, if the staff is not to spend most of its time making repairs. For this degree of accuracy and for the purposes of illustration careful sliderule calculations and careful use of plotting paper are excellent in most cases; I have not found that the average student is any more able to learn the accurate use of these materials than he is of apparatus, unless he is obliged to take the pains, and taught how.

Since the object of the laboratory work is the illustration of the laws of nature, the interpretation of the results should not be made difficult by clouds of calculation, myriads of curves or apparatus planned badly for the purpose in hand. I have sometimes been obliged to force students through laboratory directions subject to these drawbacks, and the reading of their reports has driven me to the belief that simple experimental methods, direct and well-planned computations and the use of curves when curves are the shortest way to bring out the facts, are what they need to be taught with great pains. In the elementary laboratory busy work has no place. Particularly, I am sure that in some cases where students are forced to compute results by the method of least squares the labor is worse than wasted, as certain basic assumptions of the application are not justified in the conditions of the observations. The existence of such cases was pointed out in *Nature* a good many years ago; Merriman has dealt with their theory and computation; a glance at his paper will convince any one that such treatment has no place in the elementary laboratory.

When the student has got along in his knowledge of laboratory technique he should be set at problems which involve reading and advanced observation, but this should in general be called *research* only if the undergraduate is

to be flattered thereby. I am of the opinion that the use of precision instruments in the repetition of classical experiments would be for the advanced undergraduate much better than a good deal of the "research" which he carries on with a man at his elbow to show him how, and perhaps not worse for the teacher. The study and mastery of the original articles of a series of the classical experiments, and the supervision of the experimental work, would be highly valuable for any teacher of physics.

In these days of rising costs the teacher of physics, like all the rest, should have at heart the problem of waste in his administration. As I once heard Professor B. K. Emerson say to a student, in the course of a mild rebuke for mishandling a crystal specimen, a collection is meant to be used up, but not to be destroyed; and so with apparatus. I think that the best means to meet this problem is to hold every student personally responsible for the apparatus which is intrusted to him, by keeping a personal account with him. The plan of assessing all students at a flat rate for laboratory expenses, no matter who does damage, used to seem to me little better than highway robbery on the part of the laboratory, and I have no doubt that students feel the same now. The individual account is some trouble, to be sure, but it makes each man feel responsible and act carefully, as I can testify from experience.

WILLARD J. FISHER

WORCESTER, MASS.

SCIENTIFIC EVENTS

THE RAMSAY MEMORIAL FUND

AFTER the death of Sir William Ramsay in July, 1916, a memorial meeting was held in London to commemorate his thirty-five years of service in physical and chemical sciences, education and public welfare. As was noted in SCIENCE at the time, the gathering of distinguished men, under the chairmanship of Lord Rayleigh, decided

1. To raise a substantial fund as a memorial to Sir William; and
2. To use such fund for the establishment of
   (a) Ramsay Research Fellowships, tenable wherever necessary facilities might be available, and a
   (b) Ramsay Memorial Laboratory of Engineering Chemistry at the University of London, where Sir William served twenty-six of his most fruitful years of activity.

A committee of prominent men in the physical and chemical sciences in Great Britain, including the leaders of the Coalition government and Ambassadors then accredited to the Court of St. James, was later organized. Through this general organization, committees were organized in Australia, Canada, Chile, Denmark, Holland, India, Italy, Japan, New Zealand, Spain, Switzerland and the United States. Correspondence with men of science indicate the formation of National Committees also in China, France and Sweden, and perhaps Russia.

The sum set out to be raised was £100,000. To date something over £300 have been contributed by residents of the United States.

The merits of the objects of this fund are obvious. The recognition of a man who made so many valuable contributions to our knowledge and who won so many friends through his wonderful friendly sympathy and erudition appeals especially to American men and women.

The committee expects some generous contributions and will welcome the receipt of other large gifts, but it hopes especially to have a great number of small subscribers. The receipt of checks, postal orders, or cash, for one dollar or over, sent to the Ramsay Memorial Fund Association, 50 East 41st St., New York City, will be promptly acknowledged.

UNITED STATES COMMITTEE FOR THE RAMSAY MEMORIAL FUND

Walter Hines Page, *Vice-president*	Marston T. Bogert,
Charles Baskerville, *Chairman*	Chas. F. Chandler,
Wm. J. Matheson, *Treasurer*	Francis W. Clarke,
Leo H. Baekeland,	Wm. D. Coolidge,
Wilder D. Bancroft,	John H. Finley,
	Edward C. Franklin,
	Frank Hemingway,
	Chas. H. Herty,

Charles James,
George F. Kunz,
F. Austin Lidbury,
Arthur D. Little,
C. E. K. Mees,
R. A. Millikan,
Richard B. Moore,
Wm. H. Nichols,
William A. Noyes,
Henry Fairfield Osborn,
Charles L. Parsons,
Ira Remsen,
Theodore W. Richards,
Edgar F. Smith,
E. G. Spilsbury,
Julius Stieglitz,
Milton C. Whitaker.

THE WAR DEPARTMENT COMMITTEE ON EDUCATION AND SPECIAL TRAINING

The Secretary of War authorizes the following announcement:

With a view to mobilizing the educational institutions of the country and their facilities for special training, there has been created in the War Department a "Committee on Eduction and Special Training." Associated with this committee will be five civilian educators, known as an advisory board of educators.

The committee will be composed of Col. Hugh S. Johnson, deputy provost marshal general; Lieutenant Colonel Robert I. Rees, of the General Staff, and Major Grenville Clark, of the Adjutant General's Department.

The five advisory members of the committee, whose selection has been approved by the Secretary of War, are:

Dr. Charles R. Mann, of the Carnegie Foundation for the Advancement of Teaching, and the Massachusetts Institute of Technology.

Dr. James R. Angell, of Chicago, dean of the faculties of the University of Chicago.

Mr. J. W. Dietz, of Chicago, director of education, Western Electric Company, president of the National Association of Corporation Schools.

Mr. James P. Munroe, of Boston, a member of the Federal Board for Vocational Education (which appointment will include the interests of the trade schools and schools of secondary grade).

Dr. Samuel P. Capen, of the U. S. Bureau of Education, specialist in higher education.

In these appointments it is felt that the entire educational field has been covered, since Dr. Mann is representive of engineering schools, Dr. Angell is representative of academic colleges and universities, and Mr. Dietz is from the field of schools conducted by industrial concerns. The committee will be authorized to call in from time to time other educators for consultation and assistance.

The functions of this committee will be to mobilize the country's schools and colleges behind the Army. It will encourage and arrange for the technical education of men needed by the several branches of the Army, particularly the Ordnance Bureau, the Signal Corps and the Engineers. In a degree the educational institutions are already rendering patriotic service to the government, but it is planned that there shall be a systematization of their efforts and that their facilities for technical training shall be fully utilized.

The General Order of the War Department creating the "Committee on Education and Special Training," defines its functions in the following broad terms:

> Under the direction of the Chief of Staff the functions of the committee shall be: To study the needs of the various branches of the service for skilled men and technicians; to determine how such needs shall be met, whether by selective draft, special training in educational institutions, or otherwise; to secure the cooperation of the educational institutions of the country and to represent the War Department in its relations with such institutions; to administer such plan of special training in schools and colleges as may be adopted.
>
> It is ordered that the committee shall be given such assistance, commissioned and civilian, as may be necessary to fully execute its duties, with office room in the War Department Building.

It is estimated that within the next six months 75,000 to 100,000 men will be given intensive training in schools and colleges. These men will be drawn from the armed forces of the nation, the men now in training camps or about to be called thereto, and the registrants under the selective draft act. It is expected that most of the men selected for technical training will be taken from among the men who have registered under the selective draft law and who are awaiting training and the call to the colors.

In the selection of men for intensive training in technical subjects the committee will have available the information contained in

the questionnaires which have been filled out by registrants under the selective draft law, the records and knowledge of colleges and educators of young men whose aptitude for technical service may be utilized, and the classifications of men already in training camps which have been made by the classification committee headed by Professor Walter Dill Scott.

The great demand in this war for skilled men and technicians and for educated men in many lines has been apparent. Much splendid work for the army has been done by the educational institutions in the aviation ground schools and in training specialists for various branches of the service. The Federal Board for Vocational Education has also rendered substantial service. It is now proposed to mobilize more completely the educational institutions of the country and the great educational resources of the nation, to utilize them to the utmost, and to send a large number of men to colleges, educational institutions, at an early date for intensive training in army service on technical lines.

CHEMISTRY AND THE WAR

ADEQUATE chemical control of manufacturing plants engaged in the supply of war material is now receiving the careful consideration of the War Department. The experience of both Great Britain and France teaches the necessity of conserving the supply of trained chemists, at no time large, in order that the supplies upon which the winning of the war so largely depends may not be curtailed.

Provision has now been made through an order of the Adjutant General of the Army by which manufacturers of material necessary to the prosecution of the war, who have lost the services of chemists through the first draft, may again obtain the services of these men for war work.

It is announced, also, that provision has been made by which manufacturers threatened with the loss of their trained chemists in the present draft may retain these men. Only those chemists whose services are necessary to war work will be considered, and the evidence submitted by the manufacturer must be conclusive.

Manufacturers thus affected should apply to the Chemical Service Section, N. A., New Interior Building, Washington, D. C., for the regulations governing the transfer of men already drafted, or the possible reclassification of men not yet called. This request must come from the manufacturers; applications from the men will not be considered.

SCIENTIFIC NOTES AND NEWS

DR. ALONZO E. TAYLOR, professor of physiological chemistry in the University of Pennsylvania, will give the address at the forty-second anniversary of the opening of Johns Hopkins University on February 22.

SIDNEY J. JENNINGS, vice-president of the U. S. Smelting, Refining and Mining Co., has been elected president of the American Institute of Mining Engineers to succeed Philip N. Moore of St. Louis.

THE gold medal of the Royal Astronomical Society has been presented to Mr. John Evershed for his contributions to astrophysics.

THE following important changes made in the administrative organization of the United States Public Health Service are noted in the *Journal* of the American Medical Association. Surgeon J. W. Schereschewsky has been relieved at Pittsburgh and assigned for duty as assistant surgeon-general in charge of the Division of Scientific Research. Assistant Surgeon-General J. W. Kerr, who formerly held this position, has been assigned to the director of the Hygienic Laboratory for temporary duty. Surgeon B. S. Warren has been relieved from duty with the United States Employees' Compensation Commission and has been assigned as assistant surgeon-general in charge of the Division of Sanitary Reports and Statistics. Assistant Surgeon-General J. W. Trask, who held the latter position, has been assigned to the position vacated by Surgeon Warren. Assistant Surgeon-General W. C. Rucker, in charge of domestic quarantine, has been assigned for special temporary duty with the War Department in the British Isles and on the continent of Europe in connection with maritime quarantine for the prevention of the

introduction of quarantinable diseases into the United States.

Dr. F. C. Waite, professor of histology and embryology in the schools of medicine and of dentistry of Western Reserve University, has been recalled to Washington to assist Major H. D. Arnold, M.R.C., in a new division of the Surgeon General's office. This division is to have charge of medical, dental, and veterinary students who, under the provisions of the selective service act, are enlisted in the reserve medical corps and placed on inactive service until they finish their professional training. Any student who does not make satisfactory progress will be dropped from the reserve corps and become liable to call for immediate active military service. The division is also to have oversight of the medical, dental and veterinary schools in which those men are studying, and to determine what schools throughout the country are equipped to give satisfactory professional training for medical services.

Mr. William A. Hamor, of the Mellon Institute of Industrial Research, has been called into active service as a major in the foreign chemical service section of the army.

Major Basil C. H. Harvey, professor of anatomy in the University of Chicago, has recently joined Base Hospital No. 13 at Fort McPherson, Georgia, after having served six months at Camp Cody, New Mexico, in charge of the sanitation of the camp and of the planning of the rations. Major Harvey has also conducted an army medical school in Camp Cody for training men in sanitation.

Arthur W. Ewell, professor of aeronautics at the Worcester Institute of Technology, has been appointed a captain in the aeronautic branch of the Aviation Corps and assigned to immediate foreign service. He will be attached to General Pershing's headquarters for the purpose of studying bomb dropping.

Dr. F. C. Brown, professor of physics in the Iowa State University, has received a captaincy in the ordnance department and will go to Washington, D. C., to do special research work. Dr. Brown has worked on the determination of the velocity of bullets by electrical methods.

Professor Frederick B. Slocum, of the department of astronomy at Wesleyan University, has taken up nautical work for the government and will not return to college this year.

Neil M. Judd, since 1911 assistant in the department of anthropology, United States National Museum, has been granted indefinite furlough by the Smithsonian Institution. He returned to Washington early in October, after seven months' explorations in the southwest, and shortly thereafter enlisted as a flyer in the Signal Reserve Corps.

The *Minnesota Alumni Bulletin* states that Professor Francis Jager, chief of the bee division of the agricultural department of the University of Minnesota, has been granted six months' leave of absence to head a group of men who are to go to Serbia and direct farming operations on a large tract of land. Preparations have been made and negotiations practically completed for a boat to transport machinery, seed and all the necessary equipment for the task.

T. Ralph Robinson has been appointed crop physiologist in the Bureau of Plant Industry and will be associated with Walter T. Swingle in the administration of the office of crop physiology and breeding investigations and especially in the breeding of hardy and disease resistant citrous fruits and stocks. Mr. Robinson formerly belonged to the bureau staff when he worked chiefly on soil bacteriology and water supply purification, but for a number of years he has been engaged in citrus culture in Florida.

Rev. Harry R. Caldwell has been elected to life membership in the American Museum of Natural History in appreciation of his gift to the museum of a collection from China of about 8,000 insects, and of his assistance to the Asiatic Zoological Expedition during its recent work in Yunnan. Professor C. R. Kellogg has been made a life member in acknowledgment of his aid to the Asiatic Zoological Expedition and his continued interest in the development of the museum. Dr. William

Diller Matthew has also been elected to life membership in recognition of his many services to the museum and of his scholastic attainments.

Rear Admiral Colby M. Chester, professor of naval science, will deliver to the members of the Yale Naval Training Units and others interested, a series of lectures on international law, and other naval subjects on February 11 and 18 and on the first and third Monday evenings of succeeding months.

Professor Joseph Frederic Klein, dean of the faculty and head of the department of mechanical engineering of Lehigh University for thirty-seven years, died suddenly on February 1.

Dr. Henry Maudsley, the distinguished British alienist and psychologist, has died at the age of eighty-three years.

Sir John Wolfe Barry, the eminent British civil engineer, died on January 22, in his eighty-second year.

Sir Alexander Meadows Rendel, known for his important engineering work on docks and railways in England and in India, has died at the age of eighty-eight years.

Dr. William Greenwell, F.R.S., of Durham, known for his publications on archeology, died on January 27 in his ninety-eighth year.

Miss Ethel Sargant, the English botanist, died suddenly at Sidmouth, on January 16, at the age of forty-five years.

Dr. Maryan Smoluchowski de Smolan, professor of physics at the University of Cracow, known for his work on thermodynamics, has died at the age of forty-five.

The *Journal* of the American Medical Association states that Dr. C. P. Emerson, dean of the Indiana University School of Medicine, has consulted with Governor Goodrich in regard to the construction of the new school of medicine to be built on the grounds of the Robert W. Long Hospital. The estimated cost of the new building is $365,000. The present plan is for the state to buy the old medical college building at approximately $150,000, and for the university to pay the remainder of the cost of the new building.

There is reported to be strong probability of the location in St. Louis of a reconstruction hospital as a government war institution. A site of fourteen or more acres has been tendered to the government by the municipal authorities, along with such other assistance as may be rendered by the city. It is in Forest Park, adjacent to Barnes Hospital and the Washington University Medical School, the facilities of both these institutions also being at the disposal of the national authorities, as are also those of St. Louis University. Preliminary work by the two universities embraced a broad survey of the essential advantages of St. Louis for a hospital of the nature stated, the purpose of which is to fit disabled but convalescent soldiers for maintaining themselves, by training them in the line of work best suited to their mental and physical condition. Cooperation also is to extend to finding employment for the men, and to this end the survey included industries in which would be found opportunity for the trained. The hospital, if established as seems probable, will have a capacity of 1,000 or more soldiers, and it will be under direct supervision of the national government and maintained by it. Men to be treated and instructed will enter the institution under assignment, and the entire staff will be selected from Washington. It is understood that these hospitals are to be established in several of the larger cities where are to be found the facilities in which St. Louis abounds.

The American Museum, as we learn from its *Journal*, has offered to the National War Work Council of the Young Men's Christian Association the choice of any of its thousands of miscellaneous lantern slides which may be found suitable for the entertainment of soldiers in camp, either in this country or abroad. A cable received from France by the War Work Council asked for as many colored slides as possible, with a range of subjects embracing architecture, art, science, war and the scenery of various countries. The museum is preparing also a series of lectures to be circulated among the camps. Four of these now in course of preparation are: "Hunting Elephants and

Other Big Game in Africa," by Carl E. Akeley; "Whale Hunting with Gun and Camera," by Roy C. Andrews; "Down the River of Doubt with Colonel Roosevelt," by George K. Cherrie, and "Bird Life on an Antarctic Island," by Robert Cushman Murphy. The manuscript of each lecture will be accompanied by about one hundred slides. The lecture, prepared in the first person, may be read before the soldiers with the same effect as if given at first hand. Another plan of the American Museum for providing relaxation and recreation for the soldiers, is the loan of some of the best of its motion picture films, such as the Crocker Land material and the travel films of Japan and China taken by Roy C. Andrews. These will be so fully titled and captioned that they will be self-explanatory.

Beginning with the present month the Geographic Society of Chicago will issue its monthly announcements in serial form. While the publication may not strictly be called a bulletin, it will, nevertheless, allow a little more freedom in communicating to the members of the society notices or items of general geographic and personal interest which might otherwise escape attention or record.

In answer to a question put by Sir Philip Magnus, it was recently stated by Mr. Hemins in the British House of Commons that "the Committee of the Privy Council for Scientific and Industrial Research are in the course of their administration collecting information as to research being conducted in various places and different types of institution which can not but facilitate the coordination of research work which the honorable member desires. Moreover, as he will have gathered from the annual reports of that department, similar organizations have come or are coming into existence in other parts of the empire which are in close relation with the research department in this country. As an example of what is being done in the oversea dominions, I would refer to the report of the Commonwealth Advisory Council of Science and Industry and the recently published South African Journal of Industries, which may be seen in the Colonial Office library. This imperial machinery will enable those who are engaged in our colonial trade and in our productive industries to become acquainted with the problems arising in different parts of the empire, and with the results of any researches now in progress either here or in the dominions. The establishment of research associations, which is one of the main objects of the Research Department, is intended to place at the service of our manufacturers scientific experts who may advise them or conduct in their factories special investigations."

The fourteenth annual conference of the Council on Medical Education was held at the Congress Hotel, Chicago, Monday, February 4, 1918. The morning program was devoted to medical education, and was as follows:

Opening of the conference, Dr. Horace D. Arnold, chairman, Council on Medical Education, Boston.

"Recent progress in medical education," Dr. Nathan P. Colwell, secretary, Council on Medical Education, Chicago.

"Problems of administering entrance requirements," Professor George Gailey Chambers, director of admissions, University of Pennsylvania, Philadelphia.

"The student's clinical course in medicine," Dr. George Dock, professor of medicine, Washington University Medical School, St. Louis.

"Some problems in medical education resulting from the war," Major Horace D. Arnold, M.R.C., U. S. Army, Boston.

In the afternoon the session was held jointly with the Federation of State Medical Boards of the United States, and dealt with the general topic of medical licensure, as follows:

"A central cooperative bureau of information," Dr. David A. Strickler, president, Federation of State Medical Boards of the United States, Denver.

"The civil administrative code of Illinois, and medical licensure," Francis W. Shepardson, director, Illinois Department of Registration and Education, Springfield.

"The general problem of the minor forms of healing," Hon. Howell Wright, state senator of Ohio, Cleveland.

"Sectarianism in the science of healing as treated in legislative acts and judicial decisions," Harry Eugene Kelly, formerly attorney for the

Colorado State Board of Medical Examiners, Chicago.

Tuesday, February 5, separate meetings were held by the Federation of State Medical Boards of the United States and the Association of American Medical Colleges.

Nature states that on January 2 the Institution of Civil Engineers of Great Britain completed the hundredth year of its existence, having been established in 1818 at a meeting of eight engineers at the Kendal Coffee House in Fleet Street. At the meeting of the institution on January 8, before the discussion of papers, a statement commemorative of the founding of the institution was made, present conditions precluding a more formal celebration of the centenary.

THE United States Bureau of Mines has broadened the scope of its station at Urbana, Ill., to include work in coal and metal mining and the metallurgical industries of the Middle West. The present safety work will be continued and all work will be conducted under a cooperative agreement with the mining department of the University of Illinois. The bureau staff is under the superintendence of E. A. Holbrook, supervising mining engineer and metallurgist. Other members are W. B. Plank, in charge of mine safety, and F. K. Ovitz, chemist.

IT is expected that the new Field Museum, Chicago, for which ground was broken in the summer of 1915, will be ready for the transfer of the contents of the old museum in Jackson Park by August, 1919. The new building is situated south of Twelfth Street and east of the Illinois Central Station. It is of Georgia marble, and, exclusive of the porticoes, will measure 756 feet long and 350 feet wide. It will cost $5,000,000.

THE annual report of the Bristol Museum and Art Gallery, lately published, shows great activity, in spite of the war. During the year 261,594 persons visited the museum. An important new development was in connection with wounded soldiers. Some of the collections were temporarily placed in storage and space was made for a recreation center, including frequent lectures and demonstrations, concerts, library facilities and light refreshments.

THE Minnesota state entomologist has issued an illustrated report of thirty-six pages on work upon the pine blister rust in Minnesota during 1917, in cooperation with the United States Bureau of Plant Industry. Details of inspection, scouting, infections and eradication are given. A limited number of copies are available for distribution. Applications should be mailed to State Entomologist, University Farm, St. Paul, Minnesota.

UNIVERSITY AND EDUCATIONAL NEWS

BONDS and cash amounting to $1,693,000 representing the trust fund established by Drs. Charles H. and William J. Mayo, Rochester, for carrying on medical research work at the University of Minnesota, have been turned over to the state treasurer.

BY the will of the late Mrs. Charles H. Colburn, of Milford, Mass., a fund of $100,000 is bequeathed to the Harvard Medical School for research in tuberculosis.

COLUMBIA UNIVERSITY has received $3,000 for research work in war problems from an anonymous donor and $5,000 from Clarence Mackay for surgical research work.

W. H. BENDER, associate professor of agricultural education at the University of Minnesota, has resigned to go to the State Agricultural College, Ames, Iowa, as director of vocational education and special supervisor of vocational agriculture.

AT the University of Iowa, Associate Professor R. P. Baker has been made acting head of the department of mathematics. Mr. R. E. Gleason and Mr. F. M. Weida have been appointed instructors in mathematics.

DISCUSSION AND CORRESPONDENCE

THE ELECTION OF OFFICERS BY SCIENTIFIC SOCIETIES

TO THE EDITOR OF SCIENCE: In these days of strife for democratic ideals I would like to raise the question whether the method of election followed by many of our scientific societies is not in need of democratization. To begin at home I may say that I have been

a member of the American Association for the Advancement of Science for twenty years and I think I was consulted only once in regard to a suitable candidate for the presidency of this Association. As far as I know the presidents of this Association have always been selected properly and the selections have perhaps been better than they would have been if a more democratic method had been employed, but it is questionable whether the scientific public of America takes as deep an interest in its leading scientific men as it would have taken if it had really had a part in bestowing a high scientific honor on some of them.

I have been a member of the Society of the Sigma Xi for about twenty years and do not think I have ever had any part in the selection of a candidate for national president, although I voted once or twice for the one who was nominated by a committee. It may be said that I could have wielded an influence in the selection of candidates for these high offices if I had wanted to do so but many of us have so many duties to perform that we seldom go outside this range of interests. The question is whether it should not be put in such a way that a much larger number of the scientific men would regard it as a part of their duty to take an active part in the bestowal of high scientific honors. If this is not done these honors will usually be bestowed by a few men who will generally make wise selections but will fail to arouse much general interest.

In some of the national societies devoted to special subjects there seems to be still greater need for thoroughly democratic methods of election in case we are seeking to establish in America a real democracy along these lines. Many of us regard elections as necessary evils which should receive the least possible attention. There are various other means of expressing scientific appreciation and a scientific democracy should by no means be judged mainly by the methods employed in the selection of officers. These methods have, however, their influence in creating a spirit of openness and wide interest, and it is at least conceivable that the extra labor involved in making scientific elections more democratic would be wisely spent.

G. A. Miller

ARE ZOOLOGISTS GOING TO USE THE BNA?

It is perhaps as justifiable as it is interesting that scientists are the slowest people to take hold of new ideas and radical changes. Yet there seems to be little justification for a group of men remaining silent and at the same time failing to use modern inventions in their field which have proved useful and effective.

Most zoologists are familiar with the excellent work of the Commission from the Anatomical Society which undertook the revision of the nomenclature of human anatomy. It must be a great source of satisfaction to this body of men to see how well the anatomists have responded to the simplification and standardization of terms, for now all the textbooks and many of the medical men have adopted the BNA, making a bedlam of terms easy to understand.

However, up to the present time the comparative anatomists and zoologists in general have not adopted or used this nomenclature, so that one may read of the "dorsal root" of a spinal nerve in a pig embryo and the "posterior root" of a spinal nerve in human anatomy. Indeed the workers in the field of human embryology still use terms which do not appear in the BNA.

Perhaps the most confusing set of terms are the following: anterior and posterior; dorsal and ventral, and superior and inferior. It would seem preferable to use drosal and ventral instead of anterior and posterior and then use anterior and posterior to mean superior and inferior, for there seems to be no particular need for upsetting the whole of the comparative terms to accommodate only one type of animal. But this is not a matter for one individual to decide and since the Commission has decided differently and their report has been accepted and adopted, there seems to be but one thing to do, and that is follow their nomenclature. If the zoologists wish to use the words "dorsal and ventral"

they should furnish sufficient grounds to justify changing the BNA, but if on the other hand they can not, or rather will not, then it follows that they should use the terms as they stand in the BNA.

If we are willing to stand so firmly in the principles of evolution and if we recognize man as but another animal in the long series, it seems entirely justifiable to use the same terms throughout for homologous structures, and certainly for the general space positions and orientations.

Perhaps an open discussion of the matter might be of some interest and effect; concessions might be made on both sides which will give happy results.

Thomas Byrd Magath

College of Medicine of the University of Illinois, Chicago, Ill.

RATE OF DESERT DELTA GROWTH

From the presence and position of the alluvial fans which so conspicuously mark some of the old shore-lines of ancient Lake Bonneville, that gigantic precursor of the Great Salt Lake of Utah, it is inferred that during the long period of desiccation which that vast water-body underwent the lowering of the lake level did not take place uniformly but experienced more or less protracted pauses. The most notable of these supposed halts in the recession of the waters is thought to be represented by the embankment denominated the Provo Beach.

The Provo terrace, which lies about 600 feet above the surface of the present Great Salt Lake, and 400 feet below the highest water stage of the ancient lake, is distinguished by extensive alluvial cones which are commonly regarded as true delta deposits. The great magnitude of some of these deltas is interpreted as furnishing conclusive evidence of long tarrying of the old lake waters at this level.

That the unusual size of the Provo deltas is not a necessary consequence of long lagging of lake waters at this stage seems demonstrated by recent extensive observations that enable quantitative calculations to be made of the actual time occupied in desert delta formation. The possible rapidity proves to be very much beyond all ordinary expectations. Concerning the formation of the Provo deltas there are several accelerating factors which do not obtain in the normal desert fans of alluvium that so often collect on the piedmonts at the mouths of canyons. These are the great volumes of nearby morainic materials which filled the valleys of the Wasatch and other ranges, the presence of a convenient water-body in which to concentrate the débris washed out of the canyons, and the position of the Provo level on the line where plain meets mountain.

The alluvial fans characterizing the piedmonts of many desert ranges are usually small, owing largely to the fact no doubt that the mountains have little soil material or coarse rock-waste. In some instances the alluvial débris forms merely a thin veneer over a low cone of the rocky substructure. The out-wash of boulders and pebbles serves rather as a protection against the general lowering of the plains surface through eolian erosion. Not a few of the desert fans have thus really a rock floor just as have the intermont plains themselves, and are not, strictly speaking, alluvial cones at all.

In strong contrast are the desert fans sometimes produced by normal water action. Two instances in particular may be cited in illustration of the actual rapidity with which the process sometimes goes on. Near Ivanpah, in southeastern California, a shallow trench was once dug diagonally down a sloping bajada belt in order to protect a railroad grade from possible wash of sporadic rains. Soon a cloudburst happened to come. In an hour's time a great gully 75 feet deep, 50 feet wide and several miles long was excavated in the soft soil. The bulk of the dirt was redeposited at the foot of the sloping plain in a broad fan of more than a mile radius. In another instance, near Socorro, New Mexico, the bank of an arroyo was cut to take care of future storm-waters. In a single night this spillway was deepened to 50 feet and an alluvial cone nearly 100 feet high and nearly three miles radius was formed.

It is possible and often probable that desert deltas of great size are surprisingly rapid in their growth. When chanced to be restricted by quiet bodies of water, as in the case of old Lake Bonneville, they are rendered so exceptionally conspicuous as to excite wonderment. Therefore the Provo deltas do not necessarily imply very long, or even any, tarrying of Bonneville lake surface at this level. It is possible and even probable that these deltas were actually formed during the regular or uniform recession of the lake waters. Desert delta growth may take place with unexpected rapidity, measurable by days or even hours rather than eons.

CHARLES KEYES

SCIENTIFIC BOOKS

The Botany of Crop Plants. A text and reference book. By WILFRED W. ROBBINS. P. Blakiston's Son & Co., Philadelphia, 1917, pp. xix + 681, *f. 263.* Price $2.00.

THE Botany of Crop Plants, by Wilfred W. Robbins, of the Colorado Agricultural College, is an important contribution to our text-books on economic botany. The book has been written to meet a growing demand for a text and reference book which will give the student a knowledge of the botany of common orchard, garden and field crops. To the teacher who is engaged in the teaching of botany, especially the economic phase of the subject, the work of Dr. Robbins will be found of great value.

It has been difficult to refer students to a single text-book giving an adequate discussion of this phase of botany. Botanists are to blame themselves for allowing the economic side of the subject to slip away from them. This book should, therefore, pave the way for a more adequate study of our crop plants from the standpoint of agriculture and horticulture. Botanists should make use of our cultivated plants when it is possible to utilize them to illustrate life processes.

The text-book of Dr. Robbins is divided into two parts; Part I., consisting of 8 chapters, takes up such topics as the fundamental organs of seed plants; the cell, root, stem, leaf, flower, fruit, seed and seedling, classification and naming of plants. When possible the author has used economic plants as a basis for the discussion. This portion of the text is brief, covering only 67 pages. In Part II. the author has arranged the subject from a systematic standpoint. Chapters IX.—XIX. inculsive are devoted to the grasses, first importance being given to the cereals, wheat, oats, barley, rye, maize, sorghum, rice, millet, timothy and sugar cane. Under the subject of wheat he discusses the habit of the plant, root, stem, leaf, inflorescence, spikelet, flower, pollination, artificial cross pollination, fertilization and maturing of grain, ripening stages, the mature grain, *e. g.*, ovary wall or pericarp, testa, nucellus, endosperm, aleurone layer, starchy endosperm, embryo. The author follows this botanical matter with economic phases of the subject as hard and soft wheats, millings of wheat, kinds of flour, germination of wheat, etc. He then discusses the classification of wheats, origin of wheat, environmental relations. In the bibliography some 29 references for purposes of study are referred to. The papers for the most part are accessible. One wonders why the work of Körnicke "Die Getreidearten", which is one of the best of the older works on the subject, is not referred to. However, the student will find the references given valuable in looking up material. Each one of the other cereals is taken up in the same way.

A short chapter is devoted to timothy. It would have added to the value of this chapter if some of the other forage grasses had been considered, say blue grass, which is the most important pasture plant of the northern states. This review would be unduly lengthened, should I refer to the other economic plants he has considered. Mention may, however, be made of the treatment found under the head of Moraceæ, in which the mulberry, hop, fig and hemp are taken up. In the account of the fig there is an adequate statement on pollination. This chapter, like others, gives some important references. In some cases, however, some important references are omit-

ted, as in the bibliography of the cucurbits. The author has made a most useful book and it should stimulate botanists to get some of the old lines of work back into botany, rather than let it continue to be taught by men who have other lines of interest, than botany. The book is therefore a most welcome addition to our literature of practical botany.

L. H. Pammel

Iowa State College,
Ames, Ia.

The Genera of Fishes, from Linnæus to Cuvier, 1758–1833, Seventy-five Years, with the accepted Type of Each. A contribution to the Stability of Scientific Nomenclature. By David Starr Jordan, assisted by Barton Warren Evermann. (Published by Stanford University, 1917.)

It is a reproach to zoologists that so much uncertainty exists about the proper names of animals. To an outsider it appears inexplicable that the numerous competent students of taxonomy do not put their house in order, and settle once for all the questions which they find so vexatious. The difficulty is that these matters demand exhaustive bibliographical research, and few have access to the necessary books, even if they could afford to take the time to digest them. Proposed changes, based on fragmentary research, are naturally regarded with doubt, since other investigations may show them to be needless. The only satisfactory solution must come through reviews of the whole of the pertinent literature of any group under discussion. Such a review, so far as it concerns the genera of fishes named from 1758 to 1833, is given by Dr. Jordan in a work just published by Stanford University. The various publications are enumerated in chronological order, and all the new generic names are cited, with indications of the type species. Explanatory notes, often of considerable length, are added. Thus the reader is put in possession of the facts, and is at liberty to form his own opinions. The list is doubtless substantially complete, although it is stated in the introduction that other names may yet be discovered in dictionaries and obscure publications.[1] At the end is a series of lists, showing the various necessary or possible changes in nomenclature. These lists are as follows:

(*A*) Changes resting in priority, involving 73 names, though in nine of these the generic name remains as currently accepted, only the authority being altered. It is greatly to be regretted that our common genus of darters, *Etheostoma* of all modern authors, must apparently be called *Catonotus*. The names adopted from A. F. Röse (1793) appear to me to be of doubtful validity, being mere transliterations of the Greek names of Aristotle. The work itself being in Latin, the Aristotelian names were given with Latin equivalents. The matter is of importance to entomologists as it involves the name *Phycis*, used at present for a genus of moths, the type of a subfamily.

(*B*) Changes resulting from the operations of opinions 20 and 37 of the International Commission, admitting the names of Gronow. Those of Klein are held to be equally valid or invalid. These authors do not use the Linnean binomial system, and Dr. Jordan questions the validity of the names. In spite of the opinions of the Commission, it appears evident that all these names should be rejected.

(*C*) Changes resulting from opinion 24 of the Commission, which if logically followed must also admit four names of Plumier. The Plumierian names were polynomial and we must agree with Dr. Jordan that they should be rejected. Although few, they involve some very objectionable changes.

(*D*) Hypothetical changes according to law of priority, but doubtfully eligible; apparently to be rejected under opinion 57 of the Commission.

[1] I hear from Dr. Jordan that he has found two omissions: *Congiopodus* Perry, 1811, the same as *Agriopus*; and *Rhomboides* Goldfuss, 1820, a substitute for *Rhombus* Cuvier, preoccupied.

(*E*) Changes as under *D*, but the names (of Catesby) perhaps to be regarded as Latin vernaculars.

(*F*) Changes in accord with the law of priority, but questionable on account of irregularities. These include various Arabic names of Forskal, used for divisions of genera.

(*G*) Changes due to so-called preoccupation by earlier, *nearly* identical words. These I think should be rejected as needless, following the opinion expressed in former years by Dr. Jordan and others.

(*H*) Questionable cases, similar to *G*.

Whatever we may think of all these cases, we must agree with Dr. Jordan that it is of prime importance to have them decided as soon as possible. The matter concerns all working zoologists, and these, now that they have the facts before them, should endeavor to form and express definite opinions.

The printing and appearance of the book are admirable, but it is unfortunate that the soft paper is unsuited for annotations in ink.

T. D. A. Cockerell

SPECIAL ARTICLES

THE "RAWNESS" OF SUBSOILS[1]

In his communication to Science for September 21, 1917, Dr. C. B. Lipman has raised the whole question of the relative "rawness," or unproductivity, of subsoils by putting forward the view, based upon his own observations of plant growth upon arid subsoils, that these are but little, if at all, less "raw" or unproductive than those of humid regions. In suggesting that soil investigators do not generally appreciate the facts which support such a view he states the case too mildly. Judging from their published statements they do not even suspect the existence of such facts, emphasizing as one of the most striking characteristics of the subsoils of arid regions the ability of these, when first thrown out of excavations or simply exposed by grading operations, to support a satisfactory growth of non-leguminous plants as well as of legumes. I am aware of no book or article, previous to that just referred to, in which a contrary view is expressed. This characteristic of arid subsoils, in contrast with those of humid regions, is emphasized in all text-books which refer to the matter at all, as illustrated by the following list of references:

1. "The Soil," by F. H. King, 1904, p. 29.
2. "Soils," by E. W. Hilgard, 1906, p. 163.
3. "The Principles of Soil Management," by T. L. Lyon and E. O. Fippen, 1909, p. 69.
4. "Bodenkunde," by E. Ramann, 1911, p. 527.
5. "Principles of Agricultural Chemistry," by G. S. Fraps, 1913.
6. "Soils, their Properties and Management," by T. L. Lyon, E. O. Fippin and H. O. Buckman, 1915, p. 82.
7. "Die Bodenkunkolloide," by P. Ehrenberg, 1915, p. 164.

The view that the characteristic subsoils of arid regions are lacking in rawness appears to be based almost entirely upon the observations of the late Dr. E. W. Hilgard, who, in 1892, first called attention to the matter, mentioning the following example:

> In the case of a cellar 7 to 10 feet deep, near Nevada City, California, the red soil-mass dug out was spread over part of a vegetable garden close by, and, as a venture, the annual vegetables—tomatoes, beans, watermelons, etc.—were sown just as usual. They not only did well, but better than the portions not covered, which had been cultivated for a number of years and were somewhat exhausted thereby.[2]

F. Wholtmann, of Halle, who in the early years of the present century made several visits to California, later expressed the same view, but it is not clear to what extent his conclusions were based upon his own observations, he having discussed the matter with Hilgard while in America. The common tendency to take Hilgard's conclusions on such matters as the final word is well illustrated by Ehrenberg, of Göttingen, who, in his very recent book included in the above list, mentions that

[1] Published with the approval of the Director as Paper No. 96, of the Journal Series of the Minnesota Agricultural Experiment Station.

[2] U. S. W. B. Bul. 3, p. 19.

during his many years of investigation he (Hilgard) had become the best judge of the differences of soils of humid and arid regions (p. 164).

This remarkable property of arid subsoils, repeatedly emphasized by Hilgard in his various publications and mentioned in the works of other investigators from the time of the appearance in 1904 of the late Dr. F. H. King's "The Soil" (p. 29), must surely have excited the interest of botanists, geologists and irrigation engineers as well as of agricultural investigators, not only in California, but also in arid lands on other continents. Yet until the present observations of Dr. Lipman no word of criticism has appeared.

The accepted view, in brief, has been that on the freshly exposed subsoils in humid regions inoculated legumes as well as non-leguminous plants fail to make a satisfactory growth, one at all comparable with that on adjacent surface soils, while under similar conditions in arid regions the subsoil may be expected to show practically as good a growth as adjacent surface soil. The question of the *maintenance of productivity* in the case of the non-legumes on the arid subsoils has not been raised, interest centering upon the initial performance of the freshly exposed material. With the humid subsoils the "rawness" understood has not been absolute sterility, as Lipman appears to assume, but a low productivity. Lipman recognizes and confirms by his own observations the productivity of arid subsoils toward inoculated legumes, but denies that non-legumes make any satisfactory growth on these. While recognizing the characteristic sterility toward non-legumes of subsoils of humid regions he doubts the existence of any proof that inoculated legumes will not grow on humid subsoils. He uses the term "grow" but, as the whole question is whether the plants "thrive" and not whether they are barely able to make a weakly, stunted growth, it is desirable to discuss the matter as though "thrive" had been employed. In short, he considers "the lack of available nitrogen probably is sufficient to account for the rawness of subsoils" of both humid and arid regions toward non-leguminous plants and questions the existence of any rawness in the case of inoculated legumes.

While the views current upon the subsoils of arid regions may be due to Hilgard alone, those upon the subsoils of humid regions are founded upon the observations of numerous investigators in Europe as well as in America. Many of these may antedate 1886, the year in which Hellriegel established the rôle of symbiotic bacteria in the growth of legumes, but in the thirty years that have since elapsed it is surprising that none from among the hundreds of agricultural investigators in humid regions has called attention to the earlier false explanation, if the failure of such crop plants on exposed subsoils were due only to the lack of inoculation. The universally accepted idea of the rawness of humid subsoils in general is based not upon pot experiments or upon the growth of plants upon subsoils exposed by grading operations or thrown up from excavations, but upon observations of the growth of the crops in fields where the plow had unwisely been run a few inches below the usual depth of cultivation, with the result that the fields for years after had shown in their lessened crop returns the unproductivity of the subsoil brought to the surface. In view of the almost universal distribution of red clover in western Europe and in the humid states of this country the necessary bacteria could rarely have been missing. If the rawness were due simply to lack of inoculation such deeply plowed fields might be expected to have shown, when sown to small grains with the usual accompaniment of clover seed, a remarkably vigorous growth of the legume accompanying the failure of the cereal, a phenomenon which could scarcely have escaped mention.

In the very article by Alway, McDole and Rost,[3] which has called forth the statements of Lipman, such a phenomenon has been described. The field of 5 acres is in a railway cut near Blair, Nebraska, where about 17 years previously the surface material had been removed to an average depth of 25 feet. It had never been manured or seeded to a legume crop, but for several years had been planted to

[3] "Soil Science," Vol. 3, p. 9, January, 1917.

road Co. first lien and refunding mortgage 4 per cent. bonds, due 2008...	9,012.50	
$10,000 Northern Pacific Railway Co. prior lien railway and land grant 4 per cent. bonds due 1997.	9,187.50	
$10,000 New York Central and Hudson River Railroad Co. 3.5 per cent. bonds, due 1997.........	8,237.50	
$8,000 U. S. Second Liberty Loan Bonds.......	8,000.00	$83,037.50

Bonds from Colburn Estate

Par Value	Appraised Value	
$20,000 Acker, Merrall and Condit Co. debenture 6 per cent. bonds	$13,600.00	
$7,000 Buffalo City Gas Co. first mortgage 5 per cent. bonds	1,540.00	
$8,000 Park and Tilford Co. sinking fund debenture 6 per cent. bonds	6,400.00	
$42,000 Pittsburgh, Shawmut and Northern Railroad first mortgage 4 per cent. bonds, due February 1, 1952................	4,200.00	$25,740.00
$165,000		$108,777.50

I certify that I have audited the accounts of the treasurer of the American Association for the Advancement of Science for the period December 20, 1917, to December 15, 1917; that the securities representing the investments of the association have been exhibited and verified; and that the income therefrom has been duly accounted for.

The financial statements accompanying the treasurer's report are in accord with the books of the association and correctly summarize the accounts thereof.

(Signed) Herbert A. Gill,
Auditor

Dated December 19, 1917

L. O. HOWARD, PERMANENT SECRETARY, IN ACCOUNT WITH THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

From November 1, 1916, to October 31, 1917

Dr.

To balance from last account:		$3,836.43
To receipts from members:		
Annual dues, 1917.......	$37,818.00	
Annual dues, 1918.......	158.00	
Annual dues, previous yrs.	333.00	
Admission fees	2,085.00	
Associate membership fees.	12.00	
Life membership fees....	2,400.00	$42,806.00
To other receipts:		
Sale of publications	$45.05	
Miscellaneous receipts, including Treasurer's payment of Science subscriptions for life members, interest, postage from foreign members, sale of programs, etc	1,364.40	$1,409.45
		$48,051.88

Cr.

By publications:		
Publishers Science.......	$24,391.77	
Preliminary announcement, circulars, forms, etc.	1,644.91	$26,036.68
By expenses New York meeting:		
Sectional secretaries, commutations, accounts, etc.		920.79
By expenses Pacific Division:		
Salary of Assistant Secretary	1,200.00	
Allowance for extension and office expenses.....	603.00	1,803.00
By expenses Washington Office:		
Salary of Permanent Secretary	$1,500.00	
Salary of Assistant Secretary	1,500.00	
Extra help	1,905.75	
Postage	1,115.80	
Office supplies	180.75	
Express, telephone and telegrams	71.30	$6,273.60
By propagandist work......		3,795.46
By miscellaneous expenditures:		
To Treasurer, life membership fees	$1,000.00	
To Treasurer, gifts from members	1,395.00	
Refund of dues	50.00	
Committee on Research...	15.74	
Committee on Delegates ..	10.50	
Committee on Organization and Membership..	11.85	$2,483.09
By balance to new account		$6,739.26
		$48,051.88

The foregoing account has been examined and found correct, the expenditures being supported by proper vouchers. The balance of $6,739.26 is with the following Washington,

American Security & Trust Co.......	$2,281.42
American National Bank of Washington	2,031.84
American National Bank of Washington (Savings Department)	2,426.00
	$6,739.26

Herbert A. Gill,
Auditor

Washington, D. C.,
December 24, 1917

““SCIENCE””

FRIDAY, MARCH 1, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE SIGNIFICANCE OF THE DECLINING BIRTH RATE[1]

IT is a custom of this Section, I believe, for the retiring vice-president to select for his address a subject of national interest in the field of social economy. He is expected to avoid narrow and technical discussion of specialties but he may properly summarize the important works of other investigators in specialized fields to show their trend and bearing and he may also point out the direction which further research should take. These requirements of the occasion are all the more necessary now in view of the circumstances under which we are living. We are going through a period of serious conflict. Our nation is at present engaged in concentrating its resources of men, of materials and, above all, of thought, to make itself felt in the world struggle for preserving civilization. This is no time for trivialities or for small detail. Under these conditions, the Section on Social and Economic Science of the American Association may be expected to have a message of national import. It would be inexcusable to take your time and attention for anything but a topic of the widest practical significance in the present national emergency.

With these considerations in mind, I have chosen as the subject of this address the significance of our declining birth rate. I have done so with considerable hesitancy because of the difficulty of the subject and the importance of its present lesson. I

[1] Address of the retiring vice-president and chairman of Section I, Social and Economic Science, American Association for Advancement of Science, Pittsburgh, December 29, 1917.

shall count also on your forbearance, hoping that you will forgive the incompleteness and sketchy character of my argument. The study of American demography has convinced me that we are concerned with a problem of the greatest possible moment. Changes have been progressing in the internal structure of our population which have, for the most part, escaped attention and which, if allowed to continue, will result in very serious national embarrassment. Conditions of war bring into relief the necessity for a vigorous and efficient population. It is not too much to say that the present tendencies in our national and family life are such as seriously threaten the development of those groups in the population on which we must rely for vigor and efficiency in thought and action.

The declining birth rate has received but little scientific attention in the United States. It has been, however, the subject of very careful investigation in Europe. During the last fifty years, the birth rate has declined in virtually every country of the civilized world. Some countries have been affected more than others, but the phenomenon has been observed in extreme form in one country, namely, France. France has made an experiment in birth control on a national scale. All the parts of that experiment, including the end result, are now on view and available for scientific observation and comment. Before the present war, France had already reached a point where her birth rate had decreased to a point below her death rate; her population was actually decreasing. But for ten years before that time, the approaching crisis had called for the careful attention of her best minds.

A commission on depopulation composed of statesmen and sociologists was appointed to study the problem and a series of comprehensive reports[2] on the sources of depopulation have been prepared. These reports are too elaborate for detailed description here. I shall rather present the situation for France, as I understand it, in broad outline, bringing into relief only the main findings of the commission.

Let us consider the growth of population during the last century in the three leading countries of western Europe, namely, France, the United Kingdom and the states composing the German Empire.[3] At the beginning of the nineteenth century France was the leader of the three countries, with a population of about twenty-nine million. The states which now compose the German Empire were second, with a population of about twenty-three million, and the United Kingdom stood third with a population of about eighteen million. A century later, we find the situation totally changed. The German Empire headed the list with a population of nearly sixty-five million, the United Kingdom was second with a population of forty-five million and France was third with a population of only thirty-nine million. In other words, while the population of the German Empire had nearly trebled and the United Kingdom had increased to two and one half times its earlier numbers, the population of France had increased less than one half. Further inspection of the figures shows that a marked change in the rate of increase of the population of France occurred about the year 1860. At that time France was still in the lead and had already reached a population of thirty-seven million. After that date it

[2] A series of reports on the death rate by Bertillon, Löwenthal, Drouineau, Atthalin, Fevrier, and Strauss; and on the birth rate by Neymarck, March, Bertillon, Rey, Drouineau, Atthalin and Lyon-Caen. Melun, Imprimerie Administrative, Paris.

[3] Burn, Joseph, "Vital Statistics Explained," London, 1914, page 19.

increased only two million, while Germany in the same period almost doubled in population. In 1811, the population of France constituted 16 per cent. of all Europe. One hundred years later the French population constituted only 9 per cent. of the total.

This situation for France may be accounted for principally in terms of its declining birth rate. Such figures as I have for France show that at about 1830 the rate was 30 births per 1,000 of population.[4] The last available figure for 1914 was 18 per 1,000; the death rate was 19.6 per 1,000.[5] This was the first war year, but already in 1911 the death rate, 19.6, exceeded the birth rate, 18.7. The reduction of more than one third in the birth rate during the eighty years was both gradual and continuous. On the other hand, the birth rates in the German Empire and in the United Kingdom continued high, over 30 per 1,000 up to 1895 in the latter and up to 1909 in the former. Since then the birth rates have declined rapidly in both countries, but the enormous increases in population for both Germany and the United Kingdom were achieved before the changes in the birth rate began to make themselves seriously felt.

We are not concerned entirely with gross totals of population. Equally significant is the internal structure of population. As we shall see later, changes in the constitution of a population almost invariably appear with changes in the birth rate. This will become clearer by comparing the ages below which, one quarter, one half and three quarters of the total populations of Germany, of England and Wales and of France, respectively, are found.[6] Thus, one quarter of the population of Germany is under age eleven, one quarter of the population of England and Wales is under twelve years of age, whereas one quarter of the French population is under fourteen years. Again, one half of the population of Germany is found under 23.5 years, one half of the population of England and Wales is below twenty-six years while one half of the French population is below age thirty. We find, finally, that three quarters of the population of Germany is below age forty-one years, of England and Wales is below forty-two years and of France is below forty-nine years. These figures show clearly that the average age of the French population is considerably higher than that of the other two countries. Its youth and its strength form a smaller part of its total population, while its old and its dependents form a much larger part. This we shall find is an invariable consequence of a decreasing birth rate, which reduces the proportion of the young and thus brings into relief an undue proportion of the aged.

The declining national birth rate of France is also severely selective in character. The reduction of the birth rate has affected mostly those who are both economically and socially best fitted to bear and to raise a family to maturity. A careful classification by Bertillon[7] of the number of children per 100 families in Paris, shows that the very poor have the largest number and the very rich the smallest number of children. The order of size of the family is invariably the reverse of the order of economic condition. Since economic status

[4] "Ministere du Travail et de la Prevoyance Sociale," *Statistique Internationale du Mouvement de la Population jusqu'en 1905*, Vol. 1, 1907.

[5] Annual Report of the Registrar-General of Births, Deaths and Marriages in England and Wales, 1915, p. 71.

[6] Burn, Joseph, *op. cit.*, p. 30.

[7] Bertillon, Jacques, "Nombre d'Enfants par Familles," *Journal de la Société de Statistique de Paris*, April, 1901, p. 134.

is highly associated with efficiency and social worth, low birth rates in the best equipped groups of the population can have but one effect on the vital constitution of the next generation—namely a decline in constructive effort for national development.

Evidence suggestive of such decline in national development is afforded by the fact that coincident with a rapidly declining birth rate, France has had a high and rather stationary death rate during the last quarter of a century. England, through the development of its public health service, reduced its death rate to under 14 per 1,000 in the year before the war (1913) when France had a death rate four per 1,000 higher. In spite of the low French birth rate, the infant mortality rate has not been low, and has been coupled with a high still birth rate. The death rate from tuberculosis in France has recently come into public notice here because of war conditions, but it was high before the war. The acute infectious diseases, including typhoid fever, which have so readily lent themselves to control in other European countries and in the United States, show unsatisfactory death rates for France. In fact, we find in this country, side by side with a low rate of reproduction, evidence of indifference to the conservation of the valuable lives that are born. A disturbing element in the French situation to-day is the lack of a national public health program. Is it not possible that such conditions result directly from the absence in the community of those earnest and able men who everywhere further progress along social and economic lines? These leaders of the nation are absent because they were not born.

It is painful to say these things at this time and I should refrain from referring to them were it not for the necessity of emphasizing the facts which so directly affect our own American population problems.

The experience of England has been much less acute, although the tendency of the most recent years has been as disturbing as that in France during the previous decade. In the five-year period between 1871 and 1875, the birth rate was 35.5 per 1,000 of population.[8] In the period 1911 to 1914, inclusive, the birth rate was only 24 per 1,000. The reduction in the birth rate in England has been accompanied, to be sure, with a very healthy decline in the death rate. In the forty-odd years since 1871 this has decreased from 22 to less than 14 per 1,000; whereas the decreasing birth rate in France did not accompany any appreciable reduction in the death rate. The rate of natural increase has, however, declined in England from 13.5 in the period 1871–1875 to 10.1 per 1,000 in the period 1911–1914. England was still increasing in population at the rate of 1 per cent. annually before the war. The reduction in the rate of natural increase and certain internal changes in structure of population had, however, become a source of apprehension to English statesmen and a commission of qualified experts was appointed to study and report on the problem. Their findings[9] have been available for some time and may be summarized as follows:

The birth rate has declined to the extent of approximately one third during the last thirty-five years.

This decline has not been due to any large extent to a decline in the marriage rate or to a rise in the mean age at mar-

[8] Baines, Sir J. Athelstane, "The Recent Trend of Population in England and Wales," *Journal of the Royal Statistical Society*, London, July, 1916, p. 399.

[9] National Birth Rate Commission, "The Declining Birth Rate—Its Causes and Effects," London, 1916.

riage or to other causes diminishing the proportion of married women of fertile age in the population. The decline has been due rather to a conscious limitation of fertility in the large mass of the population.

The decline in the birth rate, although general, has not been uniformly distributed over all sections of the community. It has affected primarily those economic and social groups which, as we have shown for France, are best able to bear and maintain a good-sized family. Thus, we find that the number of legitimate births per 1,000 married males under 55 years in England and Wales was 119 for the upper and middle classes and 213 for the unskilled workmen, with a maximum of 230 among the miners.[10] The birth rate is greater as the economic and social status is lower.

Internal changes of population are taking place in England very similar to those observed in France. Under the influence of the decreasing birth rate the average age of the population of England and Wales is rising and the proportion of old persons is, of course, correspondingly increasing. If we keep in mind also that the mortality rates of females at the adult ages are progressively lower than those for males we are not surprised to find that the increasing proportion of old people is greater among females than among males. While there were, for example, 119 females per 100 males in 1871 at the ages sixty-five and over, the number in 1911 had become 132. The disturbing element in this picture is that the population is growing older not only through the increased longevity of its constituents but more especially through the decreasing reenforcement from its youth and, due to the operation of mortality, that there is a progressive excess of females over males at the older ages. The situation in England may be summed up in the words of her leading demographer, Sir J. Athelstane Baines, as follows:

> In the last forty years, the proportion of people of an age to marry has materially increased, but they marry less and later in life, and thus, to some extent, cause a reduction in the number of births. The main cause of the falling birth rate, however, is the decline in the fertility of the married, due to the voluntary restriction of childbearing, a decline which has been especially rapid since the beginning of the century. The effects of the fall in the birth rate have been neutralized, until within the last few years, by a still greater fall in the death rate. The improvement has not been so marked among the very young and the old as at adolescence and in the prime of life. While, therefore, the rate of natural increase has diminished less than the fall in the birth rate would indicate, it has been maintained at the expense of the young.
>
> As the proportion of infants with a high mortality decreased that of the ages of low mortality increased. The death rate went down, and the balance of population became economically favorable. But as the supply of infants diminishes relatively to the rest of the community, and their elders pass from their prime into the time of life when mortality is heavy, the proportionate supply of potential parents of the most prolific ages tends to decrease, the birth rate falls more rapidly, and the death rate begins to rise, leaving the margin of natural increase alarmingly narrow. The result is an older and less vigorous people; and as the vitality of women is greater than that of men, more of the former sex reach maturity, and they last longer, so that a relatively small and probably wholesome numerical superiority at the working ages is converted into a growing preponderance of old women in the vale of life.[11]

I shall now present the situation for the United States. Superficially, the facts of American population growth present a very favorable picture. Each successive census has shown a marked increase in our total population over the preceding one; that for 1910 showed an increase of nearly 16 million lives over 1900, or 21 per cent.

10 Annual Report of the Registrar-General of Births, Deaths and Marriages in England and Wales, 1912, p. xxiii.

11 Baines, Sir J. Athelstane, *op. cit.*, p. 413.

Such data as we have for births and deaths indicate a similar situation. Our birth rate is probably about 25 per 1,000 and the death rate for the entire country not far from 15 per 1,000. The difference between the birth rate and the death rate, the rate of natural increase, is about 10 per 1,000 or 1 per cent. annually. The rate is much the same as we found for England and Wales in the year before the war. No one should find fault with a rate of natural increase of 1 per cent. per year. The population problem of France would be considered on a fair way to solution if that country could maintain for a period of years a rate corresponding to even one half of that which we now enjoy in the United States.

The difficulty with our American situation is that we have been satisfied with a gross showing. We have not looked underneath the surface to observe the varying tendency in the several groups of the population and in the several sections of the country. The marked increase in our total population is in large measure the result of two factors: (1) immigration and (2) a high rate of increase in the foreign born rather than in our native stock. This is shown by the constantly decreasing proportion which the native whites of native parentage form of the total white population[12] In 1870, for example, this group formed 67.8 per cent. of the total white population in the United States, while in 1910 it had decreased to 60.5 per cent. The proportion of the foreign stock correspondingly increased during these forty years. These figures are accentuated if we turn to certain areas of the country. Thus, in the New England states the proportion of the native white stock decreased from 52.3 per cent. of the total white population in 1890 to 40.3 per cent. in 1910. In the Middle Atlantic states the native white stock decreased from 51.8 in 1890 to 44.8 in 1910. In these important areas the native stock is playing an ever smaller part in the composition of the total population. In fact a very definite tendency toward depopulation has already fastened itself upon a large part of the native stock of the country.

There has been a marked and continuous reduction in the birth rate in the United States for a period of years. In the absence of comprehensive birth statistics such as are available for European countries, we must turn to other sources which are clearly indicative of the changes which have occurred in the birth rate. We may use, for example, the number of children under 5, per thousand women in the child-bearing ages, namely, fifteen to forty-four years inclusive. Professor Willcox in a recent paper has shown that this proportion has decreased about 50 per cent. in the course of the last hundred years. At the beginning of the century there were 976 children under five for every 1,000 women between the ages of fifteen to forty-four years, whereas in 1910 the number was only 508 per thousand women at these ages. During the 60 years between 1850 and 1910 the number of children under five, per thousand women at the childbearing ages, decreased in the United States by 191 or at an average of 32 in each decade. The rate of decline in the recent decades has been so rapid that Professor Willcox[13] suggests amusedly that if it were continued over a period of a century and a half, which is a comparatively short time in the life of a nation, there would be no children at all at the end of that time.

[12] Thirteenth Census of the United States, Vol. 1, Population: General Report and Analysis.

[13] Willcox, Walter F., "Nature and Significance of the Changes in the Birth and Death Rates in Recent Years," Quarterly Publications, American Statistical Association, Boston, March, 1916, p. 1.

The decline in the birth rate in the United States has been, as elsewhere, selective in character. In Massachusetts, for example, where the best American data on birth rates are available, we find first that there has been a continuous decrease in the birth rate during the last 40 years and second, that this decrease has been most marked in the native stock. In 1910 the native stock had a birth rate of 14.9 per thousand; the foreign born birth rate was 49.1 per thousand.[14] In the same year the native death rate was 16.3 per thousand, while the foreign death rate was only 15.4.[15] There was thus an excess of deaths over births corresponding to a net annual loss of a little more than one tenth of 1 per cent. in the native stock while there was an annual increase of 3.4 per cent. among the foreign born population.

A tabulation of a significant sample of the population returns for the 1910 census shows similar differences in the fecundity of women of native and foreign parentage.[16] In a group of women under forty-five years of age, who were married for a period of from ten to twenty years, the average number of children was found to be 4.1 per married woman. The women of native parentage, however, showed an average of only 2.7 children whereas the women of foreign parentage showed an average of 4.4 per married woman. In like manner, it was found that 7.4 per cent. of the women under forty-five years, who had been married ten to twenty years, had borne no children. The women of native parentage had borne no children in 13 per cent. of the cases, whereas, the women of foreign parentage had borne no children in only 5.7 per cent. of the cases. In view of the fact that very few children are born to women who have been unproductive for a period of at least ten years, we may consider these figures as fairly reliable indices of sterility in the two groups. We find that close to 40 per cent. of the married women of native parentage had borne only one or two children, whereas the women of foreign parentage showed only 19 per cent. of their number in this group. Finally, only about 10 per cent. of the women of native parentage had five children or more whereas 33 per cent. of the women of foreign parentage belong in this group.

I hope I am not assuming too much when I infer that these figures show selection in the decline of the birth rate. The race stock which laid the foundations of our institutions during the critical period of our national existence is in large areas of the country no longer maintaining itself and its place is being taken gradually but surely by foreign races, which, as we have seen, are reproducing very rapidly.

Additional evidence of the selective character of the declining birth rate is presented in special studies on the size of families of college graduates and of men of science. Thus, Phillips[17] in his work on the birth rate among graduates of Harvard and Yale universities shows that the number of children born per married graduate has fallen from about 3.25 in the decade 1850 to 1860, to a little over 2 in the decade 1881 to 1890. Similar facts are observed in the statistics for other college graduates; but none are so low as those for the graduates of colleges for women. Thus,

14 Commonwealth of Massachusetts, Annual Report on Births, Marriages and Deaths, 1914, p. 181.

15 Mortality Statistics, 1910, United States Bureau of the Census.

16 Hill, Joseph A., "Comparative Fecundity of Women of Native and Foreign Parentage in the United States," Quarterly Publications, American Statistical Association, Boston, December, 1913, p. 583.

17 Phillips, John C., "A Study of the Birth Rate in Harvard and Yale Graduates," *Harvard Graduates Magazine*, Boston, September, 1916, p. 25.

we find that the number of children per married woman graduate of Smith College was only 1.3, of Vassar, 1.6, of Bryn Mawr, 1.7 and of Holyoke, 1.8. Even more significant is the ratio of children per graduate, which, for all of these colleges, is less than one, due to the fact that less than 50 per cent. of the graduates of women's colleges marry.[18] Professor Cattell[19] further shows in his study of 643 American men of science that the families from which the scientific men had come had an average of 4.7 children, while these scientific men who were married and whose families were completed had an average of only 2.3 children, these figures including all the children born. We shall later see how far from adequate such an average number of children is for maintaining the *status quo* in the respective groups.

In the preceding discussion I have referred frequently to the number of children per family in groups of our population and have intimated that some families were small, that others were fairly normal and that others were large. You may now properly ask me what the average number of children per family should be. The answer to the question depends upon the point of view, namely, upon the amount of natural increase one would wish to see in a generation. As there is likely to be a difference of opinion on this point, I shall attempt to show only what the number of children in a family must be, under present conditions, in order that the population may remain stationary; anything above this figure will mean natural increase, anything below will mean a decrease in population.

[18] Nearing, Nellie Seeds, "Education and Fecundity," Quarterly Publications, American Statistical Association, Boston, June, 1914, p. 126.

[19] Cattell, J. McKeen, "Families of American Men of Science," *Scientific Monthly*, March, 1917, p. 248.

It is obvious that the basis of every family is two individuals. The question then resolves itself as follows: How many children must be born to every family in order that two individuals may be raised to maturity? The number of children born must be more than two for a number of reasons. The first is the fact of mortality. The death rate is exceptionally high in the period of childhood, amounting in the first year of life to about 10 per cent. of the babies born. If we begin with 100,000 at birth and trace them through from year to year, we find that about 78,000 are alive at the average age at marriage. This is according to the mortality rate that prevails over a large portion of the United States. The rest have died. This fact alone would make it necessary that every marriage result in an average of 2½ children in order that two persons may attain the average age of marriage and replace their parents in the population. But this assumes first that all persons marry, and second, that every marriage is productive. As a matter of fact all persons do not marry. In our own country from 12 to 15 per cent. do not marry until after the reproductive period, if at all. A considerable proportion of marriages, over 7 per cent., are sterile. When we make the necessary corrections in our figures, the average number of children per family which must be born is increased to close to four[20] in order that the stock may maintain itself without increase or decrease.

I say without hesitation that a large part of the native stock of this country is in this sense not maintaining itself. It is not producing the four children that are necessary to perpetuate the stock. This fact is true primarily for those families in

[20] Sprague, Robert J., "Education and Race Suicide," *Journal of Heredity*, Washington, D. C., April, 1915, p. 158.

the population which, by economic and social standards, are best able to bear and rear 'children' families. On the other hand, those groups in our population which are economically and socially less able to raise families are still producing, on the average, in excess of the minimum necessary to maintain the *status quo*. As a result, the balance of population is in favor of the less economically efficient. The best blood of America is being constantly thinned out by the exercise of a conscious limitation of births and is being replaced by a stock of a different order. Our national standards are being levelled to meet more and more the lower quality of our population.

If I have succeeded in making a plausible diagnosis of one of our national ills, will you permit me, also, to suggest a remedy for the condition? I should say, at the outset, that since many causes have been at work to produce the end result which I have described, it will require many lines of action to improve the situation. I shall, however, suggest some thoughts which seem to me to reach the heart of the problem more nearly than any others.

The state is largely responsible for the present condition. The system of education which it has provided for the youth of the country has failed for the most part to inculcate national ideals. Our young people have grown up without a broad outlook on life. They have been taught to think in terms of personal convenience and advancement and not in terms of the common good. Democratic education is a failure if it neglects to make provision for the character of its future citizenship. Our young men and women must be taught to realize early that we do not live for ourselves; that our intellectual, economic and social advancement must be carried forward not only as tradition but more especially in terms of new vigorous and worthy personalities. Our educational system must make our various racial groups conscious of their best traditions and instil desires to see their better strains strengthened and increased as a foundation of the greater democracy of the future.

The education of our women is especially faulty in this regard. Our schools and colleges, with few exceptions, direct the thoughts and energies of our girls away from ideals of normal home life and center them upon personal refinement or upon personal ambition. It is no uncommon thing to find that girls have gone through their entire college course without a single occasion when the subject of their place in society as mothers and wives was given serious consideration. No wonder that our educated women think mainly of careers or of pleasures offered by society as the aim of existence. These are all false gods which smother the natural and wholesome instincts which every species possesses to insure its maintenance. The old virtues of womanhood need restatement to-day. Whatever else women learn in the schools, they must be educated for their place as mothers, and democratic education must make efficient provision for this primary function.

The state is guilty of another sin. It has made no provision to reward, either substantially or with esteem, the women who, realizing their obligation to the state, are willing to bring up families of normal size. The bearing and rearing of children is costly, both in energy and in funds, and must act as a check on personal ambition and on the enjoyment of the freedom and pleasures of social life. A family of four children will require the attention of the capable woman for many years. Her success as a mother will be at the expense, in the majority of cases, of her achievement in other fields. It is not asking too much

that such a woman should be favored with the admiration of the community in which she lives and not as at present with its commiseration and pity. The state may find it expedient, likewise, to encourage parenthood by considering the size of the family as a factor among others in fixing exemptions from taxes.

Individual selfishness is at bottom the source of the evil I have described. An increasing number of men and women do not assume the marital state or, when married, do not raise a family of children, because they prefer to live better than their forebears and to spend more on themselves than would be possible if they had children to raise and educate. Under present conditions children are not an economic asset. Restrictive compulsory education and child-labor laws make children an expensive luxury which only the poor can afford. In fact, there is no very good reason on the score of personal comfort alone why individuals should assume the obligations and sacrifices which large families entail. Such, indeed, is the logical conclusion of our growing materialism. Yet the shallowness of this attitude must be obvious. Men and women who to-day are rallying to the defense of the country in war time, need not be reminded that we live not for ourselves but rather for the fuller life of the community. If only the same spirit would animate us in times of peace! More would then meet their obligation to the state through parenthood. A new citizenship would then arise which would be worthy to receive the noble traditions from our past and to carry our civilization forward into the future. Our appeal must be made to the religious impulse in our individual lives. It will require all the religious power latent in our people to set us right. I do not mean the mandate of any particular religious sect but rather the ethical force which arises within us when we realize clearly our relation to the community about us and the obligation which this relationship involves. The problem of the size of the family, like a whole host of other important social questions, will be solved only when men realize the holy purpose of life, that we are here to add to the sum total of the common good, in a word, that we must leave the world better than we have found it.

In conclusion, let me emphasize the need for birth release among the healthy and normal people of our country as a primary national duty. Such release must be conscious and deliberate, the act of will of free individuals who thus express a highly moral purpose.

Louis I. Dublin

Metropolitan Life Insurance Company

MINUTES OF THE WAR EMERGENCY BOARD OF AMERICAN PLANT PATHOLOGISTS

A special meeting of the War Emergency Board was held in Washington, D. C., February 9, 10 and 11, 1918. The following commissioners were present: Professor H. H. Whetzel, chairman, of Cornell University; Dr. F. D. Kern, of the Pennsylvania State College; Dr. E. C. Stakman, of the University of Minnesota; Professor H. P. Barss, of Oregon State Agricultural College; Professor H. W. Barre, of Clemson College, S. C., and Dr. G. R. Lyman, of the Bureau of Plant Industry.

Dr. Mel T. Cook, of the New Jersey Agricultural Experiment Station, and Professor H. S. Fawcett, of the Citrus Experiment Station, Riverside, Calif., also took part in the deliberations of the board, and many of the federal pathologists were called in consultation. Open meetings were also held at which practically all the pathological workers of the Department of Agriculture were present, for discussion of the program of war emergency work.

All the commissioners reported practically universal approval of the aims and objects of

the War Emergency Board on the part of the pathologists and administrative officials directing the agricultural work of their respective districts. Hence the board is assured of active and enthusiastic support on all sides. The board will find its most important work in capitalizing and translating into action the spirit of cooperation which has been stimulated and developed by the national emergency caused by the war.

The board noted with approval the definite program of cooperation both in extension and research work adopted by the pathologists of the Southern Section in the conference held at Atlanta, Ga., January 30 and 31, which must greatly increase the efficiency of the pathological work undertaken in that section this season. It was decided that similar conferences should be called during February and March by the commissioners of the other five sections of the country, thus giving the pathological workers of each district an opportunity to discuss their common problems and decide upon definite plans for cooperative action.

Commissioner Kern reported on the progress of the census of pathologists being carried on under his direction. Enrollment questionnaires were sent out to pathologists and botanists some time ago, and all were urged to send in the names of others to whom the enrollment cards should be sent, in order that we might have as complete a census as possible of all persons able to carry on pathological work during the coming season. The response has been hearty and replies are still coming in. While it is not yet possible to make a definite statement as to the total number of available pathologists, it is already apparent that there will be a serious shortage of workers to carry out the important emergency work already planned by state and federal agencies. Every effort will be made to utilize all available men in the positions where they will be of greatest service, and lists of workers are being prepared for distribution, classifying those who have registered according to geographical location, special qualifications, length of time available for work, and in other ways.

Extension work for this season, in charge of Commissioner Whetzel, was considered at some length. The activities of the War Emergency Board in this direction must consist largely in efforts to stimulate a more concentrated and correlated attack upon certain important diseases through the established state and federal channels. It was agreed that the decision as to what extension campaigns should be pushed must be decided by the conferences of pathologists of the various sections. These are in most cases regional problems and can not be wisely decided by the board for the country as a whole.

The teaching of pathology during war times was discussed by Commissioner Whetzel. In view of the great and increasing shortage of pathological workers, all teachers of pathology should endeavor to give their promising students special training. Particular emphasis should be laid on pathological courses in many educational institutions, and such courses should be introduced where they do not now exist. An increased supply of young pathological workers should thus be assured one year from now. Moreover, during the present semester special war emergency short courses open to all students without prerequisite should be instituted to give elementary training in plant pathology with a view to preparing the students for more effective work on the farms this coming season.

Commissioner Stakman outlined his work to date on the correlation of emergency research. Responses to his questionnaire on research problems were quite general and reasonably prompt. While it was the general opinion that much pathological research can not be called strictly war emergency work on account of the uncertainty as to time of obtaining results, yet there are many research problems of a distinctly emergency nature which can and should be pushed. The great work of the board in this field will be to coordinate research work and to secure voluntary cooperation in the solution of pressing problems by working through the established state and federal agencies. Such cooperative research on a broad scale has already been begun on the subject of seed treatment for cereal smuts and will be pushed to an early conclusion in order that present uncertainties as to

the best methods of treatment for different varieties and regions may be cleared up. There are other problems calling for nation-wide cooperative attack, but in general research problems are regional and can best be organized in the sectional conferences of pathologists where the different problems are acute. Commissioner Stakman will, from time to time, issue notices of cooperative research projects which are being taken up, giving the names of the leaders and an outline of the work. The War Board felt that this work of promoting cooperative research is one of the most important it can undertake, and that it has very far-reaching possibilities affecting American plant pathology.

Commissioner Lyman, in charge of crop loss estimates, reported on the collecting of data. Very gratifying response to his request for information on this difficult subject was received from pathologists throughout the country. A questionnaire sent to the county agents also yielded valuable data on certain important diseases. As a result a large body of data, probably more extensive than has ever before been collected, is now being classified and arranged. These figures will be resubmitted to the state and federal pathologists for thorough revision with a view to making them as authoritative as possible. They will then be issued in a special number of the *Plant Disease Bulletin* for general distribution. The board agreed that these crop loss estimates should be utilized as fully as possible in educational and publicity campaigns. The board also requested the Plant Disease Survey to collect such data as may be available from all sources on losses due to transportation and storage rots.

Commissioner Kern reported on plans for the conduct of a publicity campaign. It was agreed that it is very important that the general public be more thoroughly informed as to the significance of phytopathological work, including the losses due to diseases and storage rots, the significance to the public of these losses and their connection with high prices and food shortage. All possible agencies should be employed by pathologists generally to get this information to the public which is now interested in the subject on account of war conditions. Pathologists should publish articles in newspapers and popular magazines and should embrace every opportunity to deliver popular lectures on pathological subjects before miscellaneous organizations. Exhibits, displays and motion pictures should also be utilized.

The War Emergency Board adopted the following resolutions and it is hoped that all pathologists will assist in carrying them out and in translating them into action.

WHEREAS, the situation this year as regards extension work on the control of plant diseases presents many unusual and critical features, inasmuch as never before has there been such urgent need for control work in order that the food supply may be increased, while at the same time the general application of control measures will be rendered very difficult on account of the serious shortage of farm labor, making it almost impossible for the farmer to undertake any work not absolutely essential; whereas, on this account great care should be taken that the control work advocated is such as to bring tangible results, in order that the whole subject of plant disease control may not fall into disrepute among the growers.

Therefore, be it *Resolved* that principal emphasis this year should be placed on the serious diseases of the more important food crops for which control measures are thoroughly proven, and relatively easy and cheap of application; and

Resolved that all extension workers should be carefully instructed before going into the field as to the nature and scope of the work to be undertaken and the ways and means to be employed.

WHEREAS, approximately 130,000,000 bushels of wheat and other cereals are lost annually on account of the attacks of preventable smuts, and, since this loss can be prevented easily at a cost not exceeding 3 cents per acre for materials and labor,

Therefore, be it *Resolved* that the War Emergency Board urge the enactment of legislation or the adoption of other methods for securing compulsory treatment of seed wheat, oats, barley and rye to eradicate preventable smuts and other diseases.

WHEREAS, extensive observations have shown that the common barberry (*Berberis vulgaris*) including its horticultural varieties, is an important link in the life history of stem rust of cereals in the upper Mississippi Valley, enabling it to develop and spread early in the season, thus conducing to serious epiphitotics; and whereas, the value of the common barberry in that region is

insignificant compared with the value of the cereal crops, especially since the immune Japanese variety (*Berberis thunbergii*) is displacing the common variety in popular favor,

Therefore, be it *Resolved*, that the War Emergency Board of American Plant Pathologists do hereby endorse and support the efforts to eradicate the common barberry in that region.

G. R. LYMAN,
Secretary

SCIENTIFIC EVENTS

THE YALE MEDICAL SCHOOL

PRESIDENT ARTHUR HADLEY, of Yale University, announced on February 22 to Yale men who had returned for alumni university day that the Yale Medical School, for the first time in the 104 years of its existence, possessed an endowment sufficient to insure its perpetuation and establish it in the fore rank of American medical schools.

Since June, 1914, as reported in the New York *Tribune*, the resources of the school of medicine have been increased by $2,568,812.55. This sum is exclusive of $266,075 donated for the exclusive use of the Yale Mobile Military Hospital in France.

The gifts to the school of medicine include $125,000 for the Anthony N. Brady Memorial Laboratory and an additional pledge of $500,000 for endowment from the Brady family, provided a total of $2,000,000 more was obtained.

Toward this $2,000,000 the General Education Board had promised the last $500,000. The Lauder family have given $400,000, the late Charles W. Harkness $100,000, and numerous other contributions had brought the total sum above the amount needed.

Five years ago it seemed probable that the Yale medical school would cease to exist. Despite the fact that it was then just ready to celebrate its centennial, its total endowment was less than $400,000, a sum insufficient to provide income to pay the salaries of professors.

The question of the continuance or discontinuance of the medical school was placed in the hands of men interested in Yale University. A committee consisting of the late Dr. Lewis A. Stimson, Dr. D. Bryson Delavan, Dr. William B. Coley, Dr. Joseph A. Blake and Dr. Walter James was asked to confer on ways and means with President Hadley, Dean Blumer, of the medical school, and three members of the Yale corporation.

The status of the school itself was first taken into consideration. In the face of many difficulties it had maintained so high a standard that it was ranked "Plus A," the highest class, by the American Medical Association. If the school was to continue, the conferees decided, first, it must maintain the same standards it had set. Most important, if this was to be done, was an affiliation with a hospital for teaching purposes. A second consideration insisted upon by the Yale corporation was that the mere question of pride on behalf of the university should not impel the continuance of the school. There must be a real need for it, recognized by the medical profession at large, or else it would be discontinued. This need was found to exist. The generosity of the family of Anthony N. Brady made the affiliation with the New Haven Hospital possible.

FARM PRODUCTS OF THE UNITED STATES

THE following statement pertaining to the crop achievements of 1917 and indicating what is possible in 1918 is authorized by Secretary of Agriculture Houston:

The production of food crops and of animal products is always a matter of great interest to all the people of the nation. At this particular time it is of especial interest and concern. Statistics regarding the acreages and yields of important food crops planted during the year 1917 have been available in the Department of Agriculture for some time and have been made public. The recent report of the Bureau of Crop Estimates on the number of live stock on farms and ranges, however, makes it possible now to exhibit a summary of the principal results of the farmers' operations for the year.

Naturally, when the nation entered the war on April 6, 1917, there was much confusion and apprehension as to the possibility of in-

creasing or even of maintaining agricultural production. There was special concern as to the sufficiency of the supply of labor that would be available for farming operations and much apprehension was manifested over the disturbance of the supply as the result of industrial demands and the drafting or volunteering of men for service in the army and navy. As a matter of fact, there was no little disturbance and in some sections the situation was especially acute. There were other difficulties confronting the farmers, including those of securing fertilizer and machinery in sufficient quantities at a reasonable cost.

Notwithstanding all the difficulties, however, the farmers, patriotically responding to the appeals to them and influenced by the prevailing prices, labored energetically to meet the needs of this nation for food and also those of the friendly nations in Europe. They planted the largest acreage in the history of the country, produced and harvested record crops of most products except wheat, and succeeded in increasing the number of live-stock, including not only work animals, but meat and milk animals.

The farmers of the nation planted during 1917, an acreage of 246,275,000 of the leading food crops (winter wheat, spring wheat, corn, oats, barley, rye, buckwheat, rice, Irish potatoes, and sweet potatoes), which was 23,036,000 acres (10 per cent.) greater than the acreage in 1916, and 32,339,000 (15 per cent.) greater than the average for the 5 years preceding the outbreak of the European War.

The farmers not only planted these acreages, but they harvested record crops of corn, oats, barley, buckwheat, and Irish and sweet potatoes. The total production of these products and of spring wheat and rice was 5,771,928,000 bushels, or 1,204,659,000 bushels (26 per cent.) more than in 1916, and 1,002,442,000 (21 per cent.) more than the average for the 5-year period (1910–1914). Winter wheat and rye are omitted from this comparison because the 1917 harvests of these crops were from sowings made in the fall of 1916, before the United States entered the war. It should be borne in mind in this connection that the percentage of soft corn this year was very much higher than usual, and also that the aggregate crop of spring and winter wheat harvested in 1917 was short.

During the first half of 1917 there was particular apprehension lest the number of live stock should be decreased. As a matter of fact, owing to the greater abundance of feedstuffs that the large crops of the year made available and the prevailing prices, there was revealed a most gratifying increase in the principal classes of live stock—an increase in the number of horses during the year of 353,000, or 1.7 per cent.; of mules, 101,000, or 2.1 per cent.; of milch cows, 390,000, or 1.7 per cent.; of other cattle, 1,857,000, or 4.5 per cent.; of sheep, 1,284,000, or 2.7 per cent., and of swine, 3,871,000, or 5.7 per cent.

The total estimated value of all farm products, including animals and animal products, for 1917 is given as $19,443,849,381, as against $13,406,364,011 for 1916, and $9,388,765,779 for the five-year average (1910–1914). These valuations are based upon prices received by producers, which are applied to the total output regardless of whether the products are consumed on the farms or sold.

PLAN OF WAR ORGANIZATION OF DIVISION OF MEDICINE AND RELATED SCIENCES OF THE NATIONAL RESEARCH COUNCIL

I. OFFICERS

Chairman, Richard M. Pearce (National Research Council) 1023 16th St., N. W., Washington, D. C.

Vice-chairman, Major Robert M. Yerkes, Surgeon General's Office, Washington, D. C.

Executive Committee: H. D. Dakin, 819 Madison Avenue, New York City; C. B. Davenport, Cold Spring Harbor, L. I., N. Y.; Major Simon Flexner, Rockefeller Institute, New York City; W. H. Howell, School of Hygiene, Johns Hopkins University, Baltimore, Md.; Major Chas. H. Mayo, Rochester, Minn.; Major Wm. J. Mayo, Surgeon General's Office, Washington, D. C.; Colonel F. F. Russell, U. S. Army, Washington, D. C.; E. R. Stitt, U. S. Navy, Washington, D. C.; Major V. C. Vaughan, Surgeon General's Office, Washington, D. C.; Wm. H. Welch, School of Hygiene, Johns Hopkins University, Baltimore, Md.; the *Chairman* and *Vice-chairman ex-officio*.

II. COMMITTEES INCLUDED IN MEDICAL DIVISION

1. *Anatomy Committee: Chairman,* H. H. Donaldson.

2. *Physiology Committee: Chairman,* W. B. Cannon. *Vice-chairman* and *Acting Chairman,* W. H. Howell.

(*a*) *Subcommittee for Investigations on the Physiology of Shock: Chairman,* W. B. Cannon.

(*b*) *Subcommittee on the Control of Hemorrhage: Chairman,* W. H. Howell.

(*c*) *Subcommittee on Solutions adopted for Transfusion after Hemorrhage: Chairman,* L. J. Henderson.

(*d*) *Subcommittee on Fatigue in Industrial Pursuits: Chairman,* Frederic S. Lee.

3. *Committee on Medicine and Hygiene: Chairman,* Victor C. Vaughan.

(*a*) *Subcommittee on Psychiatry: Chairman,* Stewart Paton.

4. *Psychology Committee: Chairman,* Robert M. Yerkes.

(*a*) *Subcommittee on Methods for the Psychological Examination of Recruits: Chairman,* Robert M. Yerkes.

(*b*) *Subcommittee on Tests of Special Skill: Chairman,* Edward L. Thorndike.

(*c*) *Subcommittee on Problems of Aviation, Including the Examination of Aviation Recruits: Chairman,* Edward L. Thorndike.

(*d*) *Subcommittee on Incapacity, Reeducation and Vocational Training: Chairman,* Shepherd I. Franz.

(*e*) *Subcommittee on Visual Problems: Chairman,* Raymond Dodge.

5. *Committee on Anthropology: Chairman,* Wm. H. Holmes; *Vice-chairman,* C. B. Davenport.

6. *Zoology Committee: Chairman,* E. G. Conklin.

(*a*) *Subcommittee on Medical Zoology, with groups representing (1) entomology, (2) helminthology, (3) protozoology.*

III. COOPERATING COMMITTEES (NOW EXISTING IN THE COUNCIL)

1. *Chemistry: Chairman,* M. T. Bogert.

(*a*) *Subcommittee on Biochemistry: Chairman,* Frank P. Underhill.

(*b*) *Subcommittee on Pharmaceutical Chemistry: Chairman,* Frederick B. Power.

2. *Food Committee: Chairman,* A. E. Taylor.

3. *Advisory Committee on Toxicity of Preserved Foods: Chairman,* J. J. Abel.

IV. PURPOSE

To concentrate in Washington a comparatively small body of men representing the existing committees, and thus provide for effective cooperation in the rapid organization of medical research as an aid to the solution of urgent military problems.

V. FIELD

Medicine, surgery, hygiene, physiology, anatomy, psychology, psychiatry, physical anthropology and closely related subjects.

VI. METHODS

1. To cooperate closely with the Surgeon General of the Army (through Colonel Russell) and of the Navy (through Dr. Stitt) in determining urgent problems and to enlist the aid of civilian laboratories in the solution of these problems.

2. To assist the Surgeons General of the Army and Navy in procuring trained investigators to enter the respective services as contract surgeons to undertake special field investigations during short periods of time.

3. To send, if it is considered advisable, individuals to England, France and Italy to determine the urgent problems which should be taken up without loss of time in civilian laboratories in this country.

4. To invite, if it is considered necessary, commissions or individuals from England, France and Italy to this country to advise with the Medical Division of the National Research Council.

5. To maintain correspondence with prominent medical investigators in the American Expeditionary Forces and in civilian laboratories in France, England and Italy and thus obtain reports of the important fields of research, the character of the work in progress and the needs of the workers.

6. To establish relations with and if agreeable to them, to cooperate with research organizations abroad as (*a*) British Medical Research Committee, (*b*) the Research Society recently organized in France by medical officers of American, French and British forces, and (*c*) the Committee on Medical Research of the American Red Cross in France, etc.

7. To obtain reports of all medical research organizations in this country dealing with war

problems and of individuals engaged in the investigation of war problems.

8. To maintain a bureau for the dissemination of up-to-date bibliographies of all forms of medical research bearing on war problems.

9. (*a*) Prepare lists of individuals and laboratories equipped and ready to undertake research at short notice.

(*b*) Prepare lists of individuals who will hold themselves in readiness to move from laboratory to laboratory to work for shorter or longer periods on special or emergency problems or to augment existing laboratory staffs in a group of selected laboratories.

10. To hold conferences from time to time in Washington or other central city for discussion of important research problems and methods of attack.

11. To hold military medical meetings from time to time, in the neighborhood of large cantonments for the discussion of medical problems by military and civilian physicians.

SCIENTIFIC NOTES AND NEWS

Dr. Allan J. McLaughlin, health commissioner of Massachusetts, has been recalled to Washington by federal authorities. He will become assistant surgeon-general in the public health service of the United States. As second in command he will have control of all the domestic health work, particularly with respect to the military cantonment areas.

Major Frank Billings, professor of medicine in the University of Chicago, who was appointed medical adviser to the governor of Illinois, in the creation of the medical advisory boards, has been assigned to the Provost Marshal General's office in Washington. Major Billings' work is understood to be that of adviser to the Provost Marshal in connection with the medical problems under the Selective Service Law.

Dr. Douglas W. Johnson, associate professor of physiography in Columbia University, has recently been commissioned major in the Intelligence Section of the National Army, and expects to leave for Europe on a special mission for the government.

Professor William B. Herms, associate professor of parasitology and acting head of the department of entomology, University of California, has been appointed captain in the Sanitary Corps, National Army, and has been ordered to Fort Sam Houston, Texas, for duty. Captain Herms was actively engaged during the past summer and autumn in investigating the sanitation of military camps in the western department, particularly as regards mosquitoes and flies.

Dr. Paul H. M.-P. Brinton, professor of analytical chemistry in the University of Arizona, has been commissioned captain in the Ordnance Reserve.

Albert T. Poffenberger, Ph.D., instructor in psychology in Columbia University, has been commissioned a captain in the Sanitary Corps of the National Army and will be assigned to the psychological examination of recruits.

Dr. Dennie H. Udall, professor of medicine and superintendent of the ambulatory clinic of the New York State Veterinary College, has been made a major in the Veterinary Corps of the National Army and has asked for a leave of absence for the duration of the war. Dr. W. E. Muldoon, assistant professor of materia medica of the same institution, has also been commissioned and has asked for a leave of absence.

Captain Walter L. Conwell, of Cornell University, until last June assistant professor of railroad engineering in the college of civil engineering, has been promoted to Major of the 307th Field Artillery, at Camp Dix.

A. P. Mills, assistant professor of materials in the college of civil engineering, Cornell University, received his commission as captain in the Engineer O.R.C., and is awaiting orders.

Pope Yeatman, consulting engineer of New York, has been placed in charge of the nonferrous metals department of the War Industries Board, in succession to Eugene Meyer, Jr.

At the recent meeting of the American Association of Anatomists, held in the new Institute of Anatomy at the University of

Minnesota, Professor Robert R. Bensley, of the department of anatomy at the University of Chicago, was elected president of the association.

The Nashville Natural Science Society was organized in the early autumn of 1917 by persons professionally engaged in natural science work, not including physics and chemistry. Its purpose is the advancement of science in Tennessee, and especially, in the vicinity of Nashville. The following officers were elected for the academic year 1917–18: *President,* Dr. R. M. Strong, Vanderbilt University Medical school; *Vice-president,* Dr. Edward E. Reinke, Vanderbilt University; *Secretary-treasurer,* Mr. J. M. Shaver, Peabody College; *Members of Executive Council,* Dr. A. E. Parkins, Peabody College, Dr. George M. Curtis, Vanderbilt Medical School, Mr. L. V. Silvester, Vanderbilt University.

Dr. Henri M. Ami, Canadian geologist and paleontologist, has been elected vice-president of the Geological Society of France for the year 1918, at its last meeting held in Paris. Emmanuel de Margerie, secretary of the society, in communicating the information states that the Geological Society of France desires by this choice, not only to express the esteem in which Dr. Ami himself and his work in geology are held, but also the full gratitude and the admiration of the people of France for his generous country. He adds:—"Vive le Canada! whose sons are fighting so gloriously for the defence of the Liberty of the World."

Nicholas Kozeloff, Ph.D. (Rutgers, 1917), has been appointed bacteriologist of the Louisiana Sugar Station, to succeed W. L. Owen.

Dr. George E. Hale, director of the Mt. Wilson Solar Observatory of the Carnegie Institution of Washington, and chairman of the National Research Council, gave the second lecture in the series on science in relation to the war before the Washington Academy of Science on February 21. The subject of the lecture was "Astronomy and war."

Authorities possessing an intimate knowledge of the chemical and allied industries of China will deliver illustrated talks at a joint meeting of the New York Sections of the American Electrochemical Society, Society of Chemical Industry and American Chemical Society, on March 1. The meeting will be held in Rumford Hall, Chemists' Club. One of the speakers will be H. K. Richardson, who will speak on "A chemist's view of the native industries of China."

Dr. Edmund Arthur Engler, for twenty years professor of mathematics at Washington University, St. Louis, and for ten years president of the Worcester Polytechnic Institute, and president of the Academy of Science of St. Louis at the time of his death, died after a brief illness on January 16, aged sixty-one years.

Dr. Clark Bell, long president of the Medico-Legal Society, New York, died on February 22, at the age of eighty-five years.

Professor Levi M. Umbach, professor of biology at North-Western College since 1884, died on January 27. Mr. Umbach was born in Ontario on July 15, 1853, graduated from North-Western College in 1877, and since 1884 has been teaching continuously in North-Western College with the exception of one year. Since 1888 he has held the chair of biology in the college. Professor Umbach's chief interest lay in botany, especially systematic botany. He was chiefly instrumental in gathering the herbarium of North-Western College, containing some 40,000 specimens. He was especially well acquainted with the flora of the central west, Ontario, and of the northwest, and discovered a large number of new species of plants, one of which bears his name, "Fontinalis Umbachii Cardot."

A War Research Board to centralize all government work now being done at Cornell University has been organized by the board of trustees, and President Jacob Gould Schurman has been requested to name three members of the university faculty. This board will have full charge of all work which the government wishes Cornell to do.

At the meeting of the board of regents of the University of Minnesota on January 18, a proposal by E. C. Kendall and Drs. W. L. and Charles H. Mayo to grant and convey to the University of Minnesota certain rights under letters patent of a discovery by Dr. Kendall of an agent for the treatment of diseases, which has been by him designated "Thyroxin," was submitted, and it was voted to appoint the president, the dean of the department of medicine and Dr. Rowntree a committee to consider the proposed agreement and report to the board.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of General Horace W. Carpentier, a trustee of Columbia University, who died on January 21, at the age of ninety-two years, his residuary estate is divided between Columbia University and Barnard College, providing, it is said, over a million dollars for each institution. Bequests are also made to Columbia University of about $100,000 for the Dean Lung department of Chinese and about $200,000 to the medical school. Barnard College receives $200,000 for scholarships, and $100,000 is bequeathed to the University of California. There are also bequests to hospitals and for other public purposes.

Following the monthly meeting of the Yale corporation it was announced that Professor Russell H. Chittenden had been reappointed director of the Sheffield Scientific School for a term of five years, as requested by the governing board.

Professor William A. Riley, since 1912 professor of insect morphology and parasitology in the college of agriculture of Cornell University, has been elected professor of parasitology and chief of the division of economic zoology in the University of Minnesota, and will take up his duties there at the beginning of the next academic year.

Dr. John H. Hamilton, of Albany, N. Y., has been called to the State University of Iowa to succeed Dr. M. F. Boyd, as professor of preventive medicine and state epidemiologist.

Mr. Thomas J. McCarter, M.A. (Texas, 1916), has been appointed professor of physics in North-Western College, vice Mr. C. C. Van Voorhis, resigned. Mr. McCarter formerly held a position in the faculty in the University of Texas and more recently with the Bureau of Standards at Washington, D. C.

Fred G. Allen, of Erie, Pa., a graduate of the University of Toronto, has been appointed assistant professor of electrical engineering at Lafayette College to take the place left vacant by the resignation of E. D. Tanzer, who has become assistant professor of electrical engineering at the Georgia Institute of Technology.

Dr. John T. Black, commissioner of health of the State of Connecticut, and Dr. Walter H. Brown, health officer of Bridgeport, have been appointed lecturers on public health at Yale University for the next year.

DISCUSSION AND CORRESPONDENCE

DIMINUTION OF THE ANTARCTIC ICE CAP AND THE AMELIORATION OF CLIMATE

In a recent number of Science, Marsden Manson[1] has directed attention to the highly important scientific results of the Antarctic expeditions under Captain Scott and Sir Ernest Shackleton, and has succinctly stated several broad generalizations based upon the data thus obtained. From the majority of these conclusions few glacialists would dissent, but exception must be taken to the main theme that the present diminution of the Antarctic ice cap proves the climate of the world to be undergoing a rise in temperature which will enable the "moss of polar wastes" to "be replaced by rye and wheat."

The position of the margin of ice sheet or valley glacier is a compromise between two factors: the forward or outward motion of the ice, and depletion resulting from melting or from wave action. The ice front advances when the former exceeds the later; it retreats when the relations are reversed. Variations in the rate of movement of the ice depend upon changes in temperature and in supply of new ice formed from snow. A dry glacier is a

[1] "The Bearing of the Facts Revealed by Antarctic Research upon the Problems of the Ice Age," Science, N. S., Vol. 46, pp. 639, 640, December 28, 1917.

slow-moving glacier, and a glacier is dry when it is cold. Likewise a wet glacier moves rapidly, and a wet glacier is comparatively warm. It may well happen that a slight rise in temperature would cause a forward movement of the ice edge and a slight fall in temperature a regressive movement. Again, heavy snowfall results in rapid accumulation of ice and is followed by an acceleration in the forward or outward push of the ice mass, while a lessened precipitation must result in slower movement and decrease in volume. Possibly, the present retreat of the Antarctic ice is due to a progressive desiccation of Antarctic climate. Temperature is by no means the only, nor necessarily the determining, factor.

At the same time, it is doubtless true that the climate of the globe is now warmer than it was during the episodes of extensive glaciation characterizing the Pleistocene Ice Age, which by the way, was equalled in the magnitude of its ice sheets by at least one earlier glacial period, that of late Paleozoic time. Moreover, from the geological point of view the present world-climate, with its polar refrigeration and marked climatic zones, is abnormal; the earth has offered a much more congenial environment than this throughout the greater part of its recorded history. But the data are not now sufficient to point clearly toward a swift and steady replacement of the present semi-glacial temperatures by those of normal and more hospitable range.

Placing the present moment in earth history in its true perspective with relation to the preceding geologic incidents, several alternatives arise concerning what will be disclosed on the geologic morrow. During Quaternary time oscillations in climate are recorded by at least four episodes of glaciation separated by intervals of partial or complete deglaciation. The last great swing of the climatic pendulum reached its farthest limit in the direction of refrigeration about thirty thousand years ago. It is possible that the return oscillation will carry the weather conditions back to those of the normal, ice-free, geologic period, and Quaternary glaciation will be a thing of the past. On the other hand, it is just as likely that the backward rush of the pendulum is now retarding and that soon it will be poised for another sweep in the opposite direction to bury middle latitudes beneath the weight of ice sheets of a new glacial stage. In that case we are to-day not in a post-glacial but an inter-glacial time such as that enjoyed by the men of Neanderthal, when osage oranges and paw paws flourished north of Lake Ontario and figs grew in the Kootenay Valley.

It is unfortunate that no certain selection may be made from these alternatives of the one which is imminent, for the question is one of more than academic interest. Legislation which is forward-looking, far-reaching plans for racial progress, promotion of economic welfare, all must be radically influenced by the knowledge—if we had it—that in ten thousand years the Barren Lands of the north could support a population of fifty to the square mile, or that in a similar interval the available farm lands of the globe will be reduced to half their present area.

The key which will unlock the mystery of the major climatic trend of the present time is not to be found in observations upon the terminal position of ice sheet or glacier, unless those observations are extended over centuries. It is rather to be sought in the determination of the influence which the combustion of coal in this industrial age is exerting upon the carbonic-acid content of the air, and of the headway which the warm (though unusually salt and therefore heavy) water of the Mediterranean Sea is making as it creeps outward through the Straits of Gibraltar down the sloping floor of the Atlantic ocean and spreads poleward beneath the cold but fresher water of the deep sea.

Kirtley F. Mather

Queen's University,
Kingston, Canada

LABELING OF MICROSCOPICAL SLIDES IN STAINING TECHNIQUE

There seems to be distinct need of a satisfactory method of temporarily labeling microscopical slides destined for the staining, wash-

ing, dehydrating and clearing processes in ordinary microtechnique, especially when objects and stages of diverse nature are to be passed through in large numbers at a time. Higgins's waterproof ink and preparations involving sodium silicate either wash off, or, if they survive to the end, rub off when dry in spite of even the most careful handling. West, in a recent number of SCIENCE,[1] suggests the use of numbered aluminum clips and a notebook. This method would appear to be clumsy and wasteful of time and imperfectly adapted to slides of varying thickness, besides necessitating permanent labeling of the slides as soon as the small supply of clips becomes exhausted. To meet these objections, an ink has been devised which apparently answers all ordinary requirements of the investigator. It has been used in the making of hundreds of slides, and one supply made two years ago is still giving great satisfaction.

The method of making the ink may be stated briefly as follows: 15 g. of best cabinet-makers' glue are dissolved at low temperature in 100 c.c. of water in a clear glass bottle. To this is added an excess of crystals of potassium dichromate and the mixture is exposed for a week or more to strong light, after which it is filtered. India ink is rubbed into this "stock solution," a slate ink cup or grinder being employed. A little of the solution is poured into the cup and a stick of India ink is applied, the rubbing being done with a circular motion. When sufficient blackness is obtained, the ink is removed with a dropper to a small bottle; the operation is repeated with a new supply of stock solution until a sufficient quantity of ink is accumulated. A supply sufficient for several years' use can be made in this way in the course of an hour or two.

The ink will keep indefinitely if care is taken to prevent evaporation. It may best be kept in a small narrow-neck balsam bottle with ground joint, the joint being further sealed with a thin coating of vaseline. The label end of the slide should be clean and free from fixative, when the ink will flow freely. An ordinary clean, medium-pointed steel pen may be used. A dozen slides may be labeled with accession number, thickness of ribbon and other data with a single dipping of the pen. The ink will dry thoroughly in a few minutes at ordinary room temperature, after which the slides may be passed through the alcohols, stains, water and xylol without deterioration of the label. On completion of the slides the label may be left as originally made and the slides stored in this condition until they are wanted. This will be found sufficient for most research problems. If it is desired at any time to replace the original label with a permanent one, the ink may be quickly scraped off with a scalpel and replaced by a pasted label. In doing this the figure or letter usually comes off entire with a slight lifting movement of the knife.

[1] N. S., Vol. XLVII., No. 1201, January 4, 1918, p. 22.

CHAS. H. OTIS

BIOLOGICAL LABORATORY,
WESTERN RESERVE UNIVERSITY,
CLEVELAND, OHIO

PROFESSIONAL COURTESY

IN the January, 1918, number of the *Journal of Biological Chemistry* appeared an article by E. V. McCollum and N. Simmonds, now of Johns Hopkins University, entitled "A Study of the Dietary Essential, Water-Soluble B, in Relation to Its Solubility and Stability Towards Reagents."

This work, as the article indicates, was done, but not prepared for publication, in the laboratory of agricultural chemistry of the University of Wisconsin. The authorship of this article does not properly give credit to those participating in this research. On page 62 a footnote briefly states that "Credit is due Mr. H. Steenbock for the preparation of the extracts employed in this work." This representation is a gross injustice to Professor Steenbock and displays a marked transgression of common professional courtesy and ethical standards on the part of the authors of this article. Professor Steenbock not only contributed much, if not all, to the thought expressed in the preamble of this article, but the details of making the vitamine preparations and the

chemical work in reference to their stability reappear in the text practically verbatim as they were developed by him in his own notebooks. The method of experimentation on vitamine stability as published in this paper was the outgrowth of methods previously employed by Professor Steenbock in experiments with pigeons. He should at least have appeared as a joint author of this article.

Inasmuch as the records of rat feeding, although they were part of a continuing project of the experiment station, were removed in toto from the campus with the change in staff and consequently no longer available, it had not been possible for Professor Steenbock to correlate this material for publication.

E. B. HART
Chairman of the Department of Agricultural Chemistry, University of Wisconsin

SCIENTIFIC BOOKS

Outlines of Comparative Anatomy of Vertebrates. By J. S. KINGSLEY, Professor of Zoology in the University of Illinois. Philadelphia, P. Blakiston's Sons & Co. Second Edition, Revised. 1917. Pp. 449.

A well-known teacher of comparative anatomy has characterized Professor Kingsley's "Outlines of Comparative Anatomy of Vertebrates" as "the best text-book of comparative anatomy in the English language." The rapid exhaustion of the first edition and the appearance of the second suggests that many other teachers share his opinion. The second edition is enlarged by the addition of fifty pages of reading matter and contains sixty more text-figures than the first edition, while the fundamental plan of the book remains unchanged. A list of Greek and Latin roots has been added to help the student to understand the meanings of the anatomical and embryological terms used.

From extended experience as a teacher of comparative anatomy Professor Kingsley has learned that a plain diet of anatomy is unacceptable to the average college undergraduate. "Boning" and "grinding" are college synonyms and the undergraduate does neither gladly. Anatomy therefore in the Kingsley text is made more palatable by the addition of enough physiology to give it flavor—and "meaning" in terms of function. Furthermore, an embryological approach to the study of each organ system is calculated to give a clearer conception of the fundamental relationships of the system within the organism as a whole. The text is well written with these pedagogical ends in view.

College students, however, are interested in comparative anatomy chiefly because of the bearing of the facts upon the theory of evolution in general and upon the history of the human body in particular. The text fails in general to utilize this interest. Were the bearing of the evidence upon the important problem of human phylogenesis more frequently pointed out and were much material devoid of such human interest omitted, the text would undoubtedly lose somewhat as a reference book in comparative anatomy, but it would make a much stronger appeal to undergraduates.

In its lucid and accurate descriptions and careful classification of materials the book serves as an admirable example of the scientific method. Its generalizations and interpretations, moreover, are cautious and based upon exceptional familiarity with animal structure and acquaintance with the extensive literature of comparative anatomy and embryology. The spirit of the book is open-minded and undogmatic. Errors of statement in the second edition are relative few. The statement (p. 132) that "the somatic wall of the myotome does not participate in muscle formation" needs qualification, since it is not true of all vertebrates. The retractor bulbi muscle (p. 134) is a derivative of the third and not of the first head cavity (Johnson, '13; Miss Fraser, '14). The electric organ of *Astroscopus* (p. 142) comes from the superior oblique muscle as well as from the muscles innervated by the oculomotorius. The "limiting sulcus" (sulcus of Monro) is not a characteristic feature of vertebrate embryos in general, as might be inferred from the descrip-

tion on page 148. It should not be forgotten that the nervous character of the so-called thalamic nerve (mentioned on p. 184) has never been demonstrated, nor is it so certain that "the eye grows out from the dorsal zone of the forebrain" since that depends upon what is taken to be the morphological anterior end of the brain.

Is the conclusion (p. 191) justified that "since the vagus is a cranial nerve, its distribution to heart, stomach and lungs, shows that these structures belong to the head"? Possibly they do, but by the same token so does the tail belong to the head since this also is innervated by a branch (N. lateralis) of the vagus. In the light of what we now know regarding nerve histogenesis is it not time that the dogma of a primary, unalterable connection between nerve and its terminal organ were abandoned? Fats are spoken of (p. 220) as "hydrocarbons," although the term is used by organic chemists only in reference to oxygen-free carbon compounds. Considering the scope of the book, however, such exceptional errors are not surprising. In a field where the possibilities of divergent opinion are so many it is remarkable that the book contains so few statements to which exception may be taken.

Numerous illustrations, mostly from original sources, constitute one of the most distinctive features of the book. The unusual skill of the author as an artist is shown especially in the admirable stereograms scattered through the book, which in this respect makes another real contribution to the pedagogy of comparative anatomy. The outline drawings, however, are not always easily analyzed by the eye and might be improved by more contrast. The addition of a diagram to illustrate some of the more important fiber tracts of the vertebrate (Mammalian?) brain would aid the description on page 153. A few errors of labelling persist in the second edition. The numbers of the first and second head cavities are interchanged in Fig. 270. In Fig. 336 the right and left post-cardinals are incorrectly labelled as "post-cavæ." In Fig. 378 the two oviducts are shown as uniting in a "urinary bladder." Some typographical errors there are of course. The book as a whole however, is one in which American morphologists may take just pride as an admirable piece of work by an American zoologist of distinction aided by an American publisher of high ideals of typographic workmanship.

Herbert V. Neal

Tufts College, Mass.

A Year of Costa Rican Natural History. By Amelia S. Calvert and Philip P. Calvert.

The chief object in the visit of these two entomologists to Costa Rica was a study of the dragonflies with special reference to their life-histories and seasonal distribution. However, in the preface, we are told: "Our investigations have not yet been completed and we have little to say in these pages on that technical subject. What we here set forth are chiefly our more incidental observations recorded in our diary." The first point made by the authors is in regard to the changes which will be induced by the Panama Canal. We are given no hint of the factors productive of such changes or of their nature or extent. But in view of the expectations of such transformations, it is a pity that a delay of about eight years has intervened between the expedition and this publication of the general résumé of its results.

The authors have shown wisdom in rewriting their notes and doing away with any diary form. They have grouped their observations geographically and when several separate visits were made to any one place, these are grouped in a single chapter. As the five hundred pages of text deal chiefly with disconnected, casual notes, with annotated facts and identifications, it is impossible to offer anything like a detailed criticism. The excellent index places this information in a form readily available for reference. The volume is filled with interesting matter and adumbrates what must be the all-important scientific work of the future—the direct correlation of field work with that of the laboratory and museum. As we might expect, the chief interest was insects, although plants form a close second in

amount of space. In the case of the latter, many photographs aid in familiarizing the reader with the forms of flowers and foliage. Notes on mammals and birds are almost absent. A single instance of a bird feeding upon lepidoptera was noticed. On the other hand, copious notes were made on the natives, their customs, mode of life, houses and villages. But the matter relating to dragonflies, the discovery of the various forms and the rearing of their larvæ, stand out from all the rest of the text. In dealing with this phase of research, the enthusiasm is distinctly greater, the diction more pleasing, and the treatment more thorough.

The text presents many readable descriptions of scenery and of unexpected conditions in this tropical country. Such a one is the strawberry field with its amazing amount of delicious fruit, shaded by tall rose trees. And the last chapter has a most vivid narrative of a disastrous earthquake in which the whole city of Cartago was ruined and several hundred people killed. The authors fortunately escaped with their notes and photographs. They go on to recount: "The falling wall carried with it the tumbler shelf so that the larvæ, the rearings of many months, were all killed—with one extraordinary exception. A bottle of new *Cora* larvæ which P. brought with him the evening before from Juan Vinas —the rarest thing we had—was found on the floor, unbroken and with the larvæ alive!"

In addition to the well-made index there are several appendices dealing with the itinerary, temperature and rainfall records, a summary of papers published in connection with the collections made on the trip, and a systematic list of plants and animals mentioned. As this latter has the page references, the contents of the volume are thus made still more available for reference. The authors are to be sincerely congratulated on having saved their incidental notes and observations from oblivion. Such work can not fail to add to any breadth of generalizations in their own more narrow field of special, intensive work, and sets a standard for other expeditions which it is hoped will often be equalled or surpassed. "The Voyage of the Beagle" is bearing late fruit and should be a stimulus to all such effort in the future.

WM. BEEBE

NEW YORK ZOOLOGICAL PARK

SPECIAL ARTICLES

THE EFFECT OF OMNIVOROUS AND VEGETARIAN DIETS ON REPRODUCTION IN THE ALBINO RAT

AN experiment, now in its fifth year, is being carried on to show the effect of a vegetarian diet as compared to an omnivorous diet on reproduction in the albino rat in regard to:

1. The relative number of litters produced.
2. The relative number in the litter.
3. The relative frequency of producing litters.
4. The relative ratio of the sexes.
5. The relative vitality and growth of the young.
6. The relative longevity and general appearance.
7. The relative age at which breeding begins and ceases.
8. The general effect upon successive generations.
9. Sterility test; to determine whether it is the male or the female which is rendered impotent.

The number of pairs constantly under observation was 40. Approximately 20 of these pairs were restricted to a vegetarian diet and the remaining, used for control, were given the same vegetables with some form of animal food added. As soon as one of a pair died the other was remated. Or when they became too old to breed they were discarded and the cage restocked.

The results and conclusions so far reached may be summarized as follows:

If only those pairs which produce litters are taken into consideration the average number of litters per pair for the omnivorous group is 3.73 and for the vegetarian, 1.93. But when the whole group of matings are considered we find that 11.5 per cent. of the omnivorous and 55.9 per cent of the vegetarian pairs failed to reproduce. If these are considered, the average number of litters is

reduced to 3.15 and .89 per pair respectively. This is a ratio of about 3.6 to 1 in favor of the omnivorous feeders.

The greatest number of young born by a single pair is 41 in the omnivorous group and 23 in the vegetarian group. The average number of young for each mating is 15 for the omnivorous feeders and 4 for the vegetarian.

The number of young eaten by the parents is 19.5 per cent. in the omnivorous group and 35.8 per cent. in the vegetarian.

The ratio of sexes in the two groups is 113.6 males to 100 females in the omnivorous young and 107.6 males to 100 females in the vegetarian young.

The average weight (both sexes) of the omnivorous young at birth is 4.59 grams and the vegetarian young is 4 grams. A much heavier weight is maintained by both sexes of the omnivorous rats throughout their lives as shown in the curves of growth. This is shown in the following table. The retardation of growth of the new born vegetarians appears to be due to the decreased lactation of the mothers.

The average age at which the first litter was born was 169 days for the omnivorous and 223 days for the vegetarian rats.

The oldest age at which a litter was born in the omnivorous group was 570 days and in the vegetarian, 600 days. The average ages were 330 and 334 days respectively. The average duration of the period of reproductive activity in the omnivorous group is thus 161 days and in the vegetarian group 111 days. The restricted diet thus appears not only to delay the period of reproductive activity, as other writers have found, but also to actually shorten the duration of this period.

Matings were made to test which sex was the cause of the failure to reproduce. Vegetarian pairs, when they ceased to reproduce, were separated. New healthy omnivorous males were mated to the vegetarian females and new healthy omnivorous females were mated to the vegetarian males. All these new matings failed to reproduce. The conclusion drawn is that a vegetarian diet produces sterility in both sexes.

It has been impossible to determine the effect of a continued vegetarian diet on the race, as only two or three successive generations have been reared on this diet before the line of descent became extinct. We must therefore conclude that a vegetarian diet not only reduces the vitality, the growth, and the ability to reproduce, but tends to the extermination of the race.

..	Avg. No. Litters per Breeding Pairs	Percentage of Non-breeding Pairs	Total Avg. No. Litters	Greatest No. Litters	Greatest No. Born from Single Pair	Avg. No. Born per Pair	Avg. No. in Litters	Avg. Wt. in Grams at Birth	Avg. Wt. in Grams at 30 Days	Avg. Wt. in Grams at 600 Days	Ratio of Sexes of Young	Percentage of Young Eaten by Parents	Youngest Age in Days of Mother at 1st Litter	Avg. Age in Days of Mother at 1st Litter	Oldest Age in Days of Mother at Last Litter	Avg. Age in Days of Mother at Last Litter	Avg. Interval in Days Between Litters
Omnivorous..........	3.7	12%	3.15	9	41	15	4.8	4.59	28.8	208	113♂ to 100♀	19.5%	90	169	570	330	67
Vegetarian	1.9	56%	.89	3	23	4	4.5	4.00	15.7	140	107♂ to 100♀	35.8%	119	223	600	334	97

The difference in appearance of the two groups is very marked. The vegetarians are smaller, have less vigor, are less active, have rougher hair and a tendency to sore eyes, while the omnivorous are the reverse in these respects.

The earliest ages at which the first litter was thrown is 90 days for the omnivorous and 119 days for the vegetarian group. Since the period of gestation is 21 days the age of sexual maturity in each of these cases was 59 and 98 days respectively.

The average age at which the first litter

We are expecting to have the complete paper ready for publication in the near future.

J. R. Slonaker,
T. A. Card

Department of Physiology,
Stanford University, Calif.

SCIENCE

Friday, March 8, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE MANUFACTURE OF ORGANIC CHEMICALS AT THE UNIVERSITY OF ILLINOIS

Before the outbreak of the present war, a large percentage of all the organic chemicals used in this country, which included dyestuffs, developers and drugs, as well as the substances needed exclusively in scientific research, were imported from Europe. The largest part of these chemicals came from Germany and as soon as trade relations with that country were broken off shortly after the war began, it was necessary for the United States from that time to depend almost entirely upon the small stock on hand. An immediate growth in the chemical industry in this country took place and manufacturers were busy filling the demand, first, for the simpler substances as phenol, aniline and beta naphthol, then the more complex substances as hydroquinone, aspirin, salol, amidol, etc. Recently commercial concerns have been working, and are at present working, upon the more fancy chemicals, particularly among the dyestuffs and drugs. Until within the last six months, however, no attempt has been made to prepare either the complex organic chemical reagents needed in analytical work or substances used exclusively in scientific research. The supply of such chemicals in this country in 1914, held chiefly by large distributing houses and university laboratories, was considerable so that by careful conservation on the part of the universities and greatly advanced prices on the part of the distributing houses, a serious lack of these compounds was not felt until this last year. Nevertheless, for the past two winters it has become necessary in universities where large amounts of organic chemical research have been carried on, for a student to spend a considerable part of his time which under normal conditions would be devoted to original investigation, in preparing various

substances which previously he had been able to purchase. The manufacturers have had good reason for not undertaking the production of such substances, because the number of chemicals of considerable commercial value not yet manufactured in this country is still large and it has been impossible for the various concerns to obtain even a sufficient number of chemists for this work. Moreover, the demand for organic chemicals used exclusively for research work or the demand for organic chemical reagents in the United States is small and the methods of preparation often difficult so that no profit could be expected from such a branch of the industry. In fact, a firm would be fortunate not to incur a considerable loss in such an undertaking, provided their selling prices were reasonable.

A number of the university laboratories, in order to overcome the trouble which thus arose, made during the summer months certain chemicals necessary for the winter researches. At the University of Illinois especially, this manufacturing was taken up extensively. It was started in the summers of both 1915 and 1916, a few graduate students working out the processes for, and then preparing, a few kilos of some ten or fifteen substances. Since this plan worked out successfully, it seemed worth while to develop the work further and also to give other institutions, where organic research was being done, the benefit of the experience gained in the Illinois laboratories. Consequently, last spring a letter referring to the manufacturing and the possibility of expanding the work to fill the demand of other laboratories was sent to the departments of chemistry of over twenty of the leading institutions of the country, as well as to the larger distributing houses that might be interested. Favorable replies came in and several orders for chemicals were received in spite of the fact that at that time no quotations could be given. About ten students were retained for the work during last summer and the manufacturing was carried on from the first of June until the first of September. Shortly after the work had been started, the news of it spread and more and more requests came until nearly eighty different chemicals were prepared in amounts ranging from a few grams to over sixty pounds. A business which during the summer it was expected would be about $1,000 turned out in the neighborhood of $5,000 and the only reason it was not larger was on account of the lack of men and laboratory facilities. Especial attention was paid to the development of methods from the laboratory scale to amounts of from one to two pounds and to the elimination of expensive and needless processes which are, almost without exception, used in the teaching of elementary organic chemistry. This kind of work is of first importance to the chemical industry at present so that in addition to the advantage of saving much time for the students during the winter, special training such as they could hardly receive in any other way in a university was given to these men. Moreover, the men were paid 25 cents to 35 cents an hour, a sum sufficient to cover their living expenses.

The whole undertaking proved to be very satisfactory and great help was given all over the country. More than thirty university laboratories, many technical concerns, and many of the large distributing houses were supplied. Because of the success of the plan, arrangements were made when the university opened last fall to continue the manufacturing. Two men were given so-called manufacturing scholarships and were to devote all their time to this work for one semester, with the exception of a few hours each week spent at lectures. Several other men were hired by the hour from time to time to attempt to keep up with the orders. It has been decided to continue the work and if possible to increase the staff to four or five men doing full-time work. Since last summer, demands for chemicals have continued to come so rapidly that only a small fraction of the compounds wanted could be furnished. The number of different chemicals already sold outside of this laboratory has increased to over one hundred twenty and the value of the manufactured substances now amounts to between $8,000 and $9,000. When one considers that for the most part

the chemicals have been distributed in lots of a few grams to a few ounces, in some cases in amounts of a few pounds, it is easy to realize the labor involved in this work. Although the above figures in dollars may seem insignificant compared with those of an ordinary commercial concern they seem large for this type of manufacturing when one is reminded that very little apparatus, a few copper cans and two or three large stoneware jars, was purchased outside of the equipment already available; that the amount of each chemical manufactured at one time was generally one to two pounds, sometimes less, and never over five pounds; and that the work is being done by comparatively inexperienced men.

Many different types of chemicals have been synthesized. Of those badly needed in analytical work may be mentioned dimethyl glyoxime, nitroso beta naphthol, cupferron, nitron, ninhydrin. Dimethyl glyoxime, before it was ready for sale by the University of Illinois, was entirely off the market. This reagent is most valuable for the quantitative determination of nickel and without it nickel steel manufacturers and analytical laboratories had to use less satisfactory methods in their nickel analyses. Although only extremely small amounts of this substance are needed for a determination, over 60 pounds were sold within the first month. Nitroso beta naphthol is a reagent for the quantitative separation of cobalt and nickel, nitron for the quantitative determination of nitric acid and nitrates, cupferron for the quantitative separation of copper and iron, and ninhydrin is used as a delicate testing reagent for alpha amino acids. The demand for these has been comparatively small but, nevertheless, urgent. Other chemicals widely used in synthetic organic chemistry have been made, such as malonic ester, acetoacetic ester, ortho and para nitro benzoic acids, dimethylamine hydrochloride, allyl alcohol and acetonitrile. In one or two instances, chemicals as amyl alcohol and amyl acetate of a very high degree of purity have been prepared for certain biological laboratories, or again, as ethyl benzene, for certain physico-chemical work. Various rarer chemicals to be studied for their insecticidal action as furfural and chloropicrin, others for their various physiological properties as tetranitromethane or mercury dimethyl have been synthesized and finally many uncommon chemicals needed purely for scientific research. Especial attention has been given to the purity of all the chemicals sold. They have been carefully tested and in many cases have been compared with samples of Kahlbaum's products which had been obtained before the war. Wherever this was done, it was found that those manufactured at Illinois were certainly as good and in many cases much better than the imported materials.

In general, the chemicals have been sold at a price which would cover labor, raw materials, and a general overhead charge and when sold to commercial concerns, a slight profit was added. Whenever chemicals were made which in ordinary times had been manufactured on a large scale, for the most part in Germany, it was generally impossible to make them at a price approaching that which existed before the war. If, however, the chemicals were those which had never been manufactured on a large scale, it was found that even though the raw materials were much more expensive than previous to 1914, in practically every case the cost was either below, or never much above the 1914 Kahlbaum price. If only a few grams of a substance were made, it was natural that the charge had to be high if expenses were to be covered. Thus whenever it seemed probable that there might be a future demand for these substances, a larger amount was synthesized and kept in stock, thus lowering the price and possibly being of aid to other laboratories at a later time.

Recently a committee has been appointed by the President of the American Chemical Society consisting of five organic chemists, one from each of five of the leading institutions in the country, Johns Hopkins, Chicago, Michigan, Columbia and Illinois. The purpose of this committee is to arrange for cooperation in this work among the scientific schools, hoping thus to cover much more ground than one university possibly could.

Innumerable difficulties are involved with such a plan but it is hoped it may be successful.

Within the last few months, two small commercial concerns have started developing this same branch of the industry. They have confined themselves as yet to preparing the more important reagents for which there is constant demand and to manufacturing the bacteriological stains needed so badly in physiological work. The prices charged by these firms are necessarily high, in fact so high that they are almost prohibitive to most of the university laboratories. These prices in the course of time will undoubtedly be lowered and the universities can then devote their energies exclusively to compounds required only for scientific research. It may be possible in the near future to have cooperation between these firms and the university laboratories, an arrangement which would be an advantage to all concerned.

Whether such small companies can live after the war and expand and so supply the demand for rare chemicals in this country is a question. It seems improbable that they will be able to compete with the foreign supplies unless a high tariff is levied. It is hoped however that the present work of these concerns may continue not only until the war stops but until such a time as a large chemical manufacturer as the National Aniline & Chemical Co. or the DuPont Co. will be in a position to undertake this branch of the industry in a thorough way and enter the business, not for profit but to be of real service to the country and to make the United States independent of foreign laboratories in this as well as other chemical lines. It is the present intention, at any rate, at the University of Illinois, to continue the work permanently, so that regardless of the great help that can be given outside, there may be a university where a graduate student in organic chemistry may be drilled in commercial methods before he goes permanently into technical work.

Roger Adams

University of Illinois

SHALL WE EAT WHOLE-WHEAT BREAD?[1]

The shortage of wheat and wheat flour, due to the excessive demands of the allied armies and neutral nations, has forced Federal and State Food Administrations to adopt certain policies in regard to the consumption of these very important foodstuffs. For example, steps have been taken to control the distribution of flour in a manner similar to that applied in the retail distribution of cane sugar. An educational campaign has been inaugurated with the view of educating the people to the consumption of larger quantities of the other cereals such as oatmeal, barley, rye and corn in substitution for wheat products. Another suggestion, which has met with some opposition, is that of milling a larger proportion of the wheat berry into flour, making what is usually termed a whole-wheat flour. The advocates of this idea argued that by milling a larger portion of the wheat kernel into the flour there would be less bran, shorts and middlings to be sold for stock feeds, wheat would go farther as a human food, and the amount saved would be available to assist in meeting the increased demand for wheat. The scientists and administrators supporting this view also contended that whole-wheat flour contained certain nutrients that standard patent flour did not contain and therefore was a better food and on account of the content of bran or "roughage" in the former it possessed a distinct advantage over the standard patent flour on account of its laxative action.

A counter campaign of education was immediately launched by certain of the milling interests represented by Professor Harry Snyder, formerly of the University of Minnesota. Professor Snyder has maintained throughout, both in public speech and in published articles, that "white bread is the best war bread" on account of the fact that it is more nutritious than the breads made from 82 per cent. extraction flour or flour milled from the entire

[1] Address before the University of Minnesota Section of the American Chemical Society, November 23, 1917.

grain (graham flour). Professor Snyder has gone a step further and makes the assertion that whole-wheat flour is not only less nutritious but is actually harmful, causing diarrhea and digestive disturbances. In this connection the statement is also made that the dairy industry can not be deprived of mill by-products which make up a very important part of the ration of the dairy cow.

There is little wonder that the consumer is at a loss to know what course to follow in his endeavor to do all in his power to cooperate with the government in the conservation of wheat.

It is not the object of this article to show that standard patent flour should not be milled; neither is it necessary to advocate that all of the wheat kernel should be milled into flour. The writer does contend that the attack on the higher extraction flours is unmerited, especially in view of the present situation; that whole-wheat flour is more valuable as a food material than the milling interests would lead us to believe; that whole-wheat flour when eaten with a balanced meal does not normally cause digestive disturbances, and that these views are held by many of the foremost authorities of food and nutrition in this and other countries. It might also be added that more economical feeds are available or can be made available for the dairy and animal industries.

It is to be expected that the milling interests would take the stand described above, for the people have been educated to believe that light, fluffy, white bread was the best bread for human consumption, and the milling interests have become organized both in personnel and machinery to give the people what they want regardless of its advisability. In order that the mill by-products should not represent financial loss, another artificial condition has developed in the live-stock and dairy industry. That they might dispose of the offal of the grain remaining after the manufacture of the white flour, the milling interests have encouraged the farmer to feed mill by-products, such as bran, shorts and middlings, until he has ceased to think of producing concentrated feeding materials and has become a victim of the mill-feed habit. Mill feeds have advanced in price with the result that dairy products have also increased in cost. The farmer is taught that he must feed wheat bran to procure the best results and at the present time bran is selling on the market at the exhorbitant price of \$42.00 a ton and higher. If the farmer would only realize that he could produce as much milk at less cost by growing more corn and ensilage feeds; by growing more of those very valuable protein-bearing plants, clover and alfalfa, he would never again resort to the expensive mill feeds. In addition to obtaining valuable food materials cheaper, he would be increasing the value of his land by growing these legume crops, for they build up the nitrogen content of the soil and thereby assist in establishing a more permanent system of agriculture. In addition to their high content of protein, the legumes are very valuable on account of the large quantities of other nutrients; carbohydrates are relatively high and what is of great value to the dairy cow especially is the relatively large amount of calcium in these plants. Milk always contains a large proportion of this element and when the animal does not get a sufficient quantity in the feed (this is true with mill products) she is forced to take it from her tissues, *i. e.*, her bones. This happens when she is receiving fairly large quantities of calcium in her ration.

Taking up the question of wheat as a human food, we must realize at the outset that "man can not live by bread alone." This has been proven by scientific experiment. Wheat does not contain the right quantities of nitrogenous substances; its mineral content is far from ideal and the Wisconsin Experiment Station has shown that animals fed on a diet restricted to the wheat plant (cereal and straw) did not develop in a normal manner.

Normally, 100 pounds of wheat yield about 73 pounds of standard patent flour. Compared with whole-wheat flour patent flour is somewhat lower in protein but slightly higher in carbohydrates. When whole-wheat or graham flours are burned in a calorimeter so

that the heat can be measured, Professor Snyder has found that the higher extraction flours are equal to or exceed the patent flours in heat value. In one of his publications[1] in 1897 Professor Snyder states "omitting details of the separate experiments it was found that there was practically no difference in the total digestibility of breads made from the three kinds of flour (patent, baker's and whole-wheat flours)." And in proof of his argument Professor Snyder submits the following data:

TABLE XXVII

Digestibility of Bread

	Bread from Patent Flour. Per Cent. Digested	Bread from Bakers' Flour. Per Cent. Digested	Bread from Whole Wheat Flour. Per Cent. Digested
Dry matter	94	93	93
Protein	86	84	87
Fat	87	87	86
Carbohydrates	97	97	97

These figures would lead us to believe that his conclusions are correct and we might even go further and say that the digestibility of protein was in favor of the whole-wheat flour. The protein in the whole-wheat flour was 12.81 per cent. and in the patent flour 12.44 per cent. This was in 1897. In 1901 Professor Snyder published the results of another set of experiments using other wheats and other men in the digestion trials and concluded that "while there actually may be more protein in a given amount of graham or entire-wheat flour than in the same weight of patent flour from the same wheat, the body obtains less of the protein and energy from the coarse flour than it did from the fine, because, although the including bran and germ increases the percentage of protein, it decreases the digestibility." Granting that Professor Snyder is right in either of his conclusions, we can rest assured that the difference in digestibility of the two flours is not great.

Professor Snyder states that 106 pounds of whole-wheat flour are required to be equal in nutritive value to 100 pounds of patent flour and it is upon this peg that all of the miller's arguments are hung.

[1] Bulletin 54, Minnesota Experiment Station.

Let us assume that 100 pounds of wheat are milled, yielding 73 pounds of patent flour and 100 pounds of the same wheat are milled to 82 pounds of whole-wheat flour and another 100 pounds are milled to practically 100 pounds of graham flour. Using Professor Snyder's own digestion coefficients,[2] we find that the energy available in patent whole-wheat and (graham breads were 90.9, 89.8 and 85.1 respectively. If we should feed 100 pounds of the same wheat in the form of patent flour (73 per cent. extraction), whole-wheat (82 per-cent. extraction) and graham flour, we would find that out of 182.64 large calories of heat in 100 pounds of wheat, man would actually be able to utilize for growth and development 115.64 large calories in the patent flour, 127.91 large calories in the whole-wheat flour, and 153.19 calories in the graham flour, showing a loss of 25 per cent. of available energy when patent flour is used. When the protein is compared, we find that Professor Snyder's figures show that out of 100 pounds of wheat we actually receive into the blood for tissue building purposes the following amounts of protein: patent flour, 8.75 pounds, whole-wheat flour, 9.68 pounds, and in graham flour 11.76 pounds of protein, showing a loss in patent flour of 25 per cent. of available protein.

Calculation also shows that if we feed bran, shorts or middlings to farm animals and then eat the meat, we lose from 60 to 80 per cent. of the available nutrients, which would indicate that it is more economical to utilize the greatest amount of the wheat kernel as human food and manufacture animal tissue on cheaper feeds.

The argument will be advanced that whole wheat flour costs nearly as much as patent flour and therefore the former figures are not applicable to present conditions. The present conditions are merely artificial—as soon as the people demand more of the whole-grain flours (which are milled at a lower cost than patent flour) just that soon will the price of the whole-grain flours begin to drop.

It is entirely feasible to mill higher ex-

[2] Snyder, 1903, U. S. Dept. Agr. Office Exp. Sta. Bull. 126.

traction flours at a lower cost than the present one. Millers argue that whole-wheat and graham flours do not keep in storage as long as patent flours. At the present time, this is not a question demanding consideration, for the flours are utilized within a few weeks of the time they are milled.

I do not wish to be interpreted as advocating the milling of flour containing the entire wheat kernel, but I feel that at the present time the higher extraction flours could be used to advantage.

From the standpoint of mineral nutrition, the higher extraction flours are more valuable as they contain a greater proportion of the mineral matter than the patent flours. The vitamines or growth-promoting substances of the wheat kernel are stored largely in the germ and are lost in the bran when patent flours are made. From this standpoint the higher extraction flours are more valuable.

It is an accepted fact that a large proportion of people are troubled with constipation; the higher extraction flours are valuable to correct this. In this connection we are told that the Belgian people were ordered by Mr. Herbert Hoover to make bread containing more white flour because of the digestive troubles experienced by the people on the whole-grain bread diet. Mr. W. C. Edgar, editor of the *Northwestern Miller*, states in one of his editorials that he was responsible for this order, having observed the digestive troubles experienced by the people. Mr. Hoover acted upon Mr. Edgar's suggestion. Dr. A. E. Taylor, physiological chemist at the University of Pennsylvania, went over the same ground and concluded that the people were suffering from malnutrition due to a one-sided diet, largely bread. He believes the digestive troubles to be secondary, due to broken-down constitutions and inability of the people to ward off disease. The latter conclusion seems the most logical, for the experience of the American people has been in direct opposition to the former idea, especially when eating well-balanced diets containing whole-wheat breads. In fact, we find the papers and magazines carrying advertisements of the larger milling companies advising us to eat bran in lieu of a ten-mile walk and become healthy. If we can eat wheat in the form of bran muffins and white bread, why not eat whole-wheat breads occasionally and save the miller the trouble and expense of separating them for us?

Regarding the nutritive value of the whole grain compared to the patent flours, practically all of our authorities in nutrition are agreed that the higher extraction flours are best. A government chemist of prominence wrote to 45 nutrition experts in the United States asking several questions, among which were the following:

1. "From your experience, is white bread a contributory cause of constipation?" The percentage of experts answering in the affirmative were 48.5, answering "no" 32.5 per cent., and the remainder were in doubt.

2. "Can whole-wheat or graham bread be considered helpful in constipation?" Here the affirmative answers represented 86.5 per cent. of the total number.

3. "Can long continued use of the whole-wheat or graham bread produce injurious results?" Seventy-five per cent. answered "no" to this question, while 5.8 per cent. of the writers were of the opinion that harmful effects could be expected. The others were in doubt.

4. "From the single standpoint of nutrition, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" 65 per cent. expressed themselves in favor of whole wheat or graham, 10.8 per cent. being in favor of white bread and 16.2 per cent. had no preference.

5. "From the single standpoint of the laxative effect, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" Here 86.5 per cent. of the authorities were in favor of the higher extraction flours.

6. "Considered both from the standpoint of nutrition and the standpoint of laxative effect, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" Here

again the higher extraction flours received the approbation of 78.5 per cent.

7. "From your experience, which is the best flour, white, whole-wheat or graham?" Only 8 per cent. were in favor of the white flour, while 65 per cent. expressed a preference for the other flours.

Dr. Louis Lapicque, a nutrition chemist for the French government, stated recently[8] that his experiments led him to conclude that 85 per cent. extraction is necessary in France and that "for every five parts which are added when the yield is increased from 80 to 85, four of these are available."

When the layman is debating as to the best policy to formulate in stocking the family larder, he should keep in mind that the higher extraction flours are (1) not normally harmful, (2) are digested almost as completely as the lower extraction flours, (3) contain more valuable nutrients in the form of "vitamines" or growth-promoting substances, and mineral salts, (4) can be manufactured more cheaply when the public demands more of the whole wheat flour, (5) that the laxative action is beneficial, (6) and what is more important at the present time, more grain will be released for the allied armies, and (7) that these conclusions are supported by the majority of nutrition authorities.

If it is true that food will win the war, it is certainly a patriotic duty to save and conserve our wheat. One method is to include as a part of our daily diet food products made from higher extraction flours.

R. A. Dutcher
University of Minnesota

SCIENTIFIC EVENTS

THE OUTLOOK IN FRENCH AGRICULTURE

The *Revue Scientifique* for September 22 contains a report on the position and prospects of French agriculture presented by M. Louis Mangin, of the Académie des Sciences, to the National Council of the Ligue Française on behalf of the Committee on Economic Organization of that body. According to an abstract in *Nature* wheat production has fallen to barely 70 per cent. of the pre-war crop, potatoes to 80 per cent., wine to 65 per cent. and sugar-beet to little more than 30 per cent. The situation as regards live stock shows the same disquieting features. Practically 20 per cent. of the pre-war head of cattle fell into the hands of the enemy, and ill-devised measures taken to secure the meat supply in the early days of the war further seriously accentuated the shrinkage. Although the cattle position from the point of view of numbers has since been substantially improved, the proportion of young stock is so great that substantial relief of the meat stringency can not be expected from home resources for a considerable time. The decline in numbers of sheep which had set in long before the war has been greatly accentuated. Pigs also show a decline of 38 per cent. since the end of 1913. No reference is made to the position as regards milk production. A survey of the forest area completes the tale of depleted resources, something like one eighth of this area having been already denuded, with but little provision for its replacement.

Many suggestions are put forward for the relief of the present situation and for the future restoration and strengthening of French agriculture. The claims of rice as a diluent of wheaten flour are strongly urged in view of the large supplies available in the Asiatic colonies. To overcome the difficulties of shortage of manual labor on the land, the organization of supplies of African and yellow labor is suggested, whilst further relief could be obtained by a more active policy with reference to the production and use of motor tractors and farm machinery in general. The example of England in placing this manufacture under the same control as that of munitions of war is warmly commended. Consolidation of estates is urgently necessary and should be accompanied by a revision of the register of lands. The price of corn should be left sufficiently free to rise to encourage production, whilst at the same time the rise in the price of bread should be restricted by all appropriate means. It is suggested that these two ap-

[8] *Comptes Rendus de l'Academie de Sciences*, Vol. 165, p. 143.

parently irreconcilable objects can be effectively attained through the establishment of municipal bread bureaus, which should subsidize or tax the bakers according to the fluctuations in the price of corn. This expedient was successfully resorted to during the Crimean War.

It is urged that the home production of manures should be fostered by using every measure to increase the output of sulphate of ammonia, by developing the synthetic manufacture of nitrates and ammonia from the atmosphere, and by increasing the production of superphosphate, all of which industries, it is urged, should have the same privileges as munition factories. To secure increased crops arrangements should be made for free distribution of manures to small cultivators.

Measures must be taken for restoring the head of live stock. To this end restrictions must be placed upon slaughter of home stock; the colonial resources of Madagascar and Africa must be drawn upon for meat, to be prepared there in frozen or otherwise preserved condition in order to reduce costs of transport. For the same reason abattoirs and refrigerating plants should be established in the home meat-producing districts, whereby cheaper production and reduction in the number of middlemen would be secured. The strong prejudice of the people against refrigerated or preserved meat must be broken down, and much could be done in this direction by the use of such products throughout the Army and Navy.

THE SHALER MEMORIAL EXPEDITION

AFTER the death of Professor Nathaniel Southgate Shaler a group of more than 700 Harvard alumni raised an endowment for the "Shaler Memorial Fund," the income of which was to be used for geological research. The *Harvard Alumni Journal* reports that carrying out of the purpose for which that fund was created, a Shaler Memorial Expedition was organized last year to cover much the same ground which Professor Shaler himself traversed in a journey during the summer of 1873. The expedition of 1917 set out to study the stratigraphy of the Ordovician formations from Pennsylvania to Alabama; were Professor Shaler alive, he would be especially interested in the attempt to correlate formations over so large an area, or, as he expressed it, the study of "that wonderful record of the first stages of the life and sea."

Professor J. B. Woodworth conducted the first Shaler Memorial Expedition; it went to Brazil in 1908. The expedition of 1917 to the Appalachians was conducted by Dr. Percy E. Raymond, associate professor of paleontology and curator of invertebrate paleontology at Harvard University, who started from Cambridge on August 1. He was joined at Salem, Va., by Mr. Richard M. Field, lecturer at Brown University. Thence the party worked southward as far as Bristol, Tenn. Dr. Ellis W. Shuler, of the Southern Methodist University, Texas, acted as guide from Blacksburg to Bristol.

As in Professor Shaler's expedition of 1873, the travelers of 1917 had to be "free to move in any direction." Even with the greatly improved railroad facilities, it was next to impossible, without independent means of transportation, to cross and recross the mountains along their entire length, in the time allowed. The Appalachians still remain a great barrier to the interior of our country, a fact of considerable military significance. But the automobile solved the problem of transportation, as the wagon did in 1873; although tire and engine troubled occurred, the car was a great aid in reaching distant and out-of-the-way sections, and bringing in specimens.

During the first field-season the party was able to work the principal sections between Pennsylvania and Tennessee, and it is hoped that two additional years of intensive study, especially the northward, will supply the material for a thorough description of the Ordovician rocks and faunas of the Appalachians.

The first year's work has already brought to light facts regarding the nature and distribution of sediments and faunas which are original and contrary to some preconceived ideas. The field work in Central Pennsylvania, which was started independently in 1915 by

Mr. Richard M. Field, has been completed, and the results will soon be ready for publication. The outstanding features of that section are certain peculiarities of the fauna which have been *heretofore* undescribed, and the remarkable series of limestones and dolomites, replete with phenomena significant of their origin and evolution.

WAR SERVICE FOR CHEMISTS

The secretary of the American Chemical Society, Dr. Charles L. Parsons, has prepared the following statement:

So many hundreds of letters are being received from firms and individuals that it is necessary to answer by this form letter, which covers most inquiries.

Individuals can obtain deferred classification only through the local boards or by appeal to the district boards.

Manufacturers engaged in the production of materials necessary for the war may apply by letter to the Chemical Service Section, National Army, Room 1108, Interior Building, Washington, D. C., for the return to them of necessary, trained chemists now in the army and not already transferred to chemical service. They may also apply through the Chemical Service Section for deferred classification of trained chemists necessary to the control of their operations who are not yet called. Applications from the men themselves will not be considered. Only those chemists whose services are necessary to war work will be considered. The evidence submitted by the manufacturers must be conclusive.

Students taking a regular chemical course may be enlisted in the Engineers' Reserve Corps and placed on the inactive list in order to complete their college course. The dean or president of the institution must certify, however, that their standing is such as to warrant the conclusion that they will graduate with a record equal to the first third of the graduates of the previous ten years. This does not apply to students in biological and physiological chemistry, as the Chief of Engineers has ruled that such come under the Surgeon General's Office, rather than under the Engineering Department. Students wishing to take advantage of this opportunity to receive their degrees before entering the country's service should address the Chief of Engineers, War Department, Washington, D. C., asking for the necessary blanks to be filled out for this purpose.

Transfers to chemical service are made by the War Department on request from some division of the army for the particular chemist needed. After the approval of the commanding officer and the Chemical Service Section, the man is transferred. Remember that the Secretary has no power to transfer you to chemical service. He simply brings your name and qualifications before those who have.

No one can predict how great this requirement for chemists will be. At present, although nearly 1,000 chemists are serving in a chemical capacity, some 300 men properly classified as chemists remain in the camps. Accordingly, if you enlist as a chemist before you are called, you will deprive another chemist, actually in the army, of his opportunity to render chemical service. The industries which supply the army and navy with the sinews of war need chemists and are being seriously handicapped by the depletion of their chemical personnel. Cards, giving age, training, experience, etc. (obtained from questionnaires filed with the Bureau of Mines), of all men with chemical training (known to be in the army) are kept in the office of the society. These cards are constantly consulted by those in command needing chemical assistance. Men are chosen, not to give the individual an opportunity to serve in a chemical capacity, but to find the man especially qualified for the work in hand. Accordingly, you may or may not be selected. Men with plant experience, research, physical and organic chemists, some analytical chemists, etc., have been in demand. On the other hand, there has been almost no chance to place pharmaceutical chemists, agricultural or food chemists, as the army apparently has little need for this form of chemical service, and the government itself is not manufacturing in these lines.

Chemical positions in the government service other than those by enlistment in the army and navy are obtainable only through the Civil Service Commission. They do not necessarily exempt the incumbent from military service.

Commissions seek the man. A number of chemists have been commissioned, but in almost every instance it has been by promotion from the ranks for recognized ability, or the particular man has been sought to fill a special place of responsibility or trust for which he was known to be especially fitted. The place was not made for the man, but the man was found for the place, sometimes after long search. A commission carries authority with it and is not lightly awarded, whether in the engineering, medical, or chemical branches of the service.

The War Department has ruled that no class I man may be commissioned before enlistment in a non-fighting branch of the service.

Information regarding individuals is obtained from the questionnaire on file in the Bureau of Mines, Washington, D. C. If you have not filled out one of these questionnaires, write to the Bureau of Mines, asking that one be sent you for this purpose.

When once in the army, keep me informed by post card of your military address and any change in that address, even should you be sent to France. Although you may not be chosen early among those needed for chemical service, the demand for chemists is constantly increasing, and your country may call you at any time where you are best trained to serve.

It is my duty to help place you where you can serve our country best as the need arises. It is your duty to keep me informed of your address and to accept any service to which the War Department may assign you, even if you prefer to fight in the ranks in France.

SCIENTIFIC NOTES AND NEWS

DR. JOHN M. COULTER, professor of botany in the University of Chicago, has been elected president of the Chicago Academy of Science. Professor Coulter is this year also president of the American Association for the Advancement of Science and of the American Association of University Professors.

DR. GEORGE T. MOORE, director of the Missouri Botanical Garden, has been elected president of the Academy of Science of St. Louis, to succeed the late Dr. E. A. Engler.

PROFESSOR THOMAS A. JAGGAR, JR., of the Hawaiian Volcano Observatory, has been elected a non-resident vice-president of the Washington Academy of Sciences.

DR. FRANCIS G. BENEDICT, director of the nutrition laboratory of the Carnegie Institute in Brookline, Mass., has received a gold medal from the National Institute of Social Sciences, in recognition of his "notable service to mankind." The medal was presented at the recent fifth annual dinner of the National Institute in New York City.

PROMINENCE has been given in the press to a story that Dr. Liberty Hyde Bailey, of Ithaca, former director of the College of Agriculture, has been selected by the Democratic chiefs as their candidate for nomination for governor of the state of New York. Mr. Bailey states that this action, if it has been taken, is without his consent, and that he has not been consulted in the matter.

MEMBERS of the Public Health Council, executive officers of the state department of health, and former United States Public Health Service representatives, gave a dinner in honor of Dr. Allen J. McLaughlin, commissioner of health, Boston, prior to his departure to begin work in Washington as assistant surgeon general in charge of the Division of Interstate Quarantine.

A BANQUET in honor of the ninety-fifth birthday of Dr. Stephen Smith, New York, known for his work in medicine and sanitation, was given at the Battle Creek (Mich.) Sanitarium, on February 19. Dr. Smith gave a most interesting account of the changes he had witnessed in the methods of his profession.

THE Mayo Unit, Rochester, of which Major Louis B. Wilson, U. S. Army, is director, with Captains Wayne W. Bissell and Arthur U. Des Jardins as assistant directors, has left for a mobilization point preparatory to sailing for France.

MAJOR BASHFORD DEAN, of the Bureau of Ordnance, has lately returned from a journey to England and France.

DR. R. T. CRAWFORD, associate professor of practical astronomy at the University of California, has been commissioned major in the aviation section of the Signal Corps and has been detailed for duty at the Balloon School at Fort Omaha.

CLARENCE F. HIRSCHFELD, until 1915 professor of power engineering at Cornell University, has received a commission as major in the Ordnance Reserve Corps and is now stationed in the inspection division of the Ordnance Department. He has been with the Detroit Edison Light and Power Company.

DR. PAUL E. KLOPSTEG, of the physics department of the University of Minnesota, has been granted a year's leave of absence for the

purpose of developing instruments for the Ordnance Department for measuring velocities of projectiles.

Dr. R. R. Dykstra, professor of surgery in the department of veterinary medicine of the University of Kansas, has been appointed veterinarian of the Kansas State Board of Agriculture for the year 1918.

Cecil C. Thomas has resigned his position as instructor in botany at the New York State College of Agriculture at Cornell University, to accept an assistantship in plant disinfection with the Federal Horticultural Board of the U. S. Department of Agriculture.

Major Samuel C. Prescott, of the Sanitary Corps, National Army, who is professor of biology at the Massachusetts Institute of Technology, is about to make an extended tour through the cantonments of the South and West.

Dr. Edward Clark, of Buffalo, has been relieved of his duties as acting chief of the division of child hygiene of the state department of health at Albany, and has returned to his former duty as sanitary supervisor of the western part of the state, with station at Buffalo. Dr. Herman F. Senftner, New York City, has succeeded Dr. Edward Clark as the head of the division of child hygiene, pending the release of Dr. Henry L. K. Shaw, Albany, from military service.

Dr. E. H. Leslie has resigned from his position as chief chemist of the General Petroleum Corporation of Los Angeles, and has assumed new duties as technical adviser to the sales department of the U. S. Industrial Alcohol Company and the U. S. Industrial Chemical Company. He will be located in their main offices at 27 William Street, New York City.

Dr. W. K. Fisher, of Stanford University, has been granted leave of absence until August 15 to accompany the University of Iowa's biological expedition to the British West Indies.

Professor Henry C. Sherman, of Columbia University, lectured on February 27, before the Chicago Institute of Medicine upon "Fundamental Requirements in Human Nutrition," and on February 28 spoke to the City Club of Chicago on "America's Food Problem" and to the faculty and students of Illinois University Medical College on "Nutrition and Food Economics."

The annual address of the Alpha Omega Alpha Honorary Medical Fraternity at Western Reserve Medical School was delivered on February 20 by Dr. Roger G. Perkins, professor of hygiene, whose subject was "Medical Conditions in Roumania," Major Perkins has just returned from Roumania with the American Red Cross Commission.

The building for an aeronautical school to be erected at the Carnegie Institute of Technology is to be called the Langley School of Aeronautics, in honor of Samuel Pierpont Langley.

Dr. Samuel G. Dixon, commissioner of the Pennsylvania State Department of Public Health, president of the Academy of Natural Science, formerly professor of hygiene in the University of Pennsylvania, died on February 26, at the age of sixty-six years.

Dr. Arthur H. Elliott, emeritus chief chemist of the New York Consolidated Gas Company and emeritus professor of chemistry and physics in the College of Pharmacy, died on March 2, at the age of seventy years.

Charles A. Hart, systematic entomologist of the State Natural History Survey, died suddenly of heart disease on February 17. He was a member of the American Society of Zoologists.

The death is announced of Professor Christian Hornung, Sc.D., on January 31, 1918, of arteriosclerosis, aged seventy-three years. For fifty years Professor Hornung held the chair of mathematics in Heidelberg University, Tiffin, Ohio. He is referred to as "a distinguished scholar, author of mathematical texts and correspondent of many noted astronomers and mathematicians and a member of the national societies devoted to his profession."

The Rev. A. T. G. Apple, M.A., died in Lancaster, Pa., on February 5, of angina pectoris, aged fifty-eight years. For the past eleven years Professor Apple has been pro-

fessor of mathematics and astronomy in Franklin and Marshall College and director of the Scholl Observatory. A correspondent writes: "He was an indefatigable worker and his publications on Jupiter brought him recognition both in this country and abroad. The observations and calculations in connection with this work and also that on the double stars, have been used in the Government Almanac. Professor Apple was a member of the American Astronomical Society, the British Astronomical Association and a fellow of the American Association for the Advancement of Science."

LIEUTENANT E. J. WOODHOUSE, until recently economic botanist to the government of Bengal, has died from wounds received in action in France.

THE death, at the age of fifty-eight years, is announced of Dr. G. Lepage, professor of obstetrics in the University of Paris.

THE Rockefeller Foundation has appropriated $125,000 to continue the war demonstration hospital of the Rockefeller Institute, $50,000 for the work of the medical division of the National Research Council of the Council of National Defense and $12,281 for other medical war research and relief work.

DR. T. MITCHELL PRUDDEN, emeritus professor of pathology in Columbia University, who has spent many years in the study of the small ruins of southern Colorado, has presented to the American Museum of Natural History a collection of pottery and other objects acquired during the course of his work. Dr. W. L. Hildburgh has presented to the museum a very carefully selected collection of archeological objects from New York state, containing some fine Iroquois pots and pipes. Dr. Hildburgh, known for his work in anthropology, has resided for a number of years in England.

A "GENERAL Congress of Civil Engineering" will be held in Paris on March 18–23 next. The objects of the conference, as recently explained to the French Minister of Commerce and Industry and quoted in *Nature*, are to awaken the French nation to the need for increased industrial enterprise and the attainment of industrial agreement. The Minister expressed the hope that the conference would give very close attention to such questions as the saving of fuel and the thorough utilization of intellectual and mechanical effort; wage war on waste of all kinds; and advocate the systematic utilization of by-products, and the adoption of improved scientific mechanical methods of production—in short, give that place to applied knowledge that it now merits.

THE California Academy of Sciences announces that the course of popular scientific lectures is being continued on Sunday afternoons at three o'clock in the auditorium of the Museum in Golden Gate Park as follows:

February 17. Professor E. G. Linsley, department of geology and astronomy, Mills College, "Our nearest neighbor, the Moon." Illustrated.

February 24. Dr. F. W. Weymouth, department of physiology, Stanford University, "The crab fisheries of the Pacific coast." Illustrated.

March 3. Professor Harold Heath, professor of zoology, Stanford University, "The Pacific whale fisheries." Illustrated.

March 10. Mr. Ralph Hopping, U. S. Forest Service, "Pine insects and their depredations."

SENATOR OWEN introduced into the Senate, and Representative Dyer into the House of Representatives, the following bill regarding rank of the Medical Reserve Corps of the Army:

That hereafter the commissioned officers of the Medical Corps, and of the Medical Reserve Corps of the United States Army on active duty shall be distributed in the several grades in the same ratios heretofore established by law in the Medical Corps of the United States Navy.

The Surgeon-General shall have authority to designate as "consultants" officers of either corps and retire them as the interests of the service may require.

SECRETARY of the Interior Lane has designated Bartlesville, Okla., as the location of the new experimental station of the Bureau of Mines for the investigation of problems relating to the petroleum and natural gas industries. The station is one of three new experi-

mental stations for the establishing of which the sum of $75,000 was appropriated by the last Congress. The two other stations have been located at Minneapolis, Minn., for the study of iron and manganese problems, and at Columbus, Ohio, for research connected with the ceramic and clayworking industries. The selection of Bartlesville was due to its location in the heart of the great mid-continent oil and gas field. The selection was influenced also by the offer of a free site and by the raising of $50,000 by the citizens of the town. This sum of money will be applied to the building of offices and laboratories and the purchase of engineering and chemical equipment. The technical staff of the new experimental station will study various problems having practical commercial application to the petroleum and natural gas industries, including questions of production, transportation, storage and refining of petroleum and various problems connected with the technology of natural gas. One of the greatest needs of the petroleum industry has been the coordination of scientific research with the practical side of the industry, for compared with other mineral industries it has been singularly backward in this respect. The station is aimed to act an intermediary between the facts evolved by scientific investigations and the needs of the oil industries. That is, men will be employed who will be able to gather scientific data and find out how they may be applied to the practical needs of the industry.

JACOB T. BOWNE, librarian of the Young Men's Christian Association College, has given his anthropological collection to the Springfield Museum of Natural History. The collection consists of some thousands of objects with complete catalogue giving the history of each object and the conditions under which it was found, with many bibliographical references to further sources of information. Mr. Bowne has spent fifty years in the study of primitive man, laying special emphasis upon the North American Indian, and the greater part of the collection is made up of relics of the Indians of the Connecticut Valley within twenty miles of Springfield. The specimens of Indian handiwork in stone, bone, shell and pottery were gathered from sites of ancient camps and burial places in this immediate vicinity. In addition to the objects. Mr. Bowne's gift includes several hundred books on anthropology, some of them very rare, together with archeological cabinets, manuscripts, maps and diagrams. The collection will remain in Mr. Bowne's keeping for the present. In accepting the collection for the museum, the directors passed the following resolution:

Resolved, That the directors extend to Mr. Jacob T. Bowne the hearty and appreciative thanks of the City Library Association for the gift of his extensive and finely organized anthropological collection, which is the result of many years of assiduous and discriminating study. The collection, relating especially to the North American Indian type and more particularly to the Indian of the Connecticut valley within 20 miles of Springfield, including the remains of aboriginal handiwork in stone, bone, shell and pottery, gathered from the sites of ancient camps and burial places in this immediate vicinity, forms a most desirable accession for the museum of natural history. The citizens of Springfield are deeply indebted to Mr. Bowne for his generosity in making this public gift.

UNIVERSITY AND EDUCATIONAL NEWS

THE Carnegie Corporation has presented McGill University with $1,000,000 in recognition of the institution's "devoted service and sacrifice towards Canada's part in the war."

IN the State University of Iowa this year, not a single undergraduate in the College of Liberal Arts qualified for the Sigma Xi. Although students are taking their studies more seriously than in former years the records show that the ablest students have been drawn into war service.

DR. RUSSELL A. HIBBS, of the University of Louisville, has been appointed professor of orthopedic surgery in the college of physicians and surgeons of Columbia University. Dr. Eugene W. Caldwell, of Bellevue Hospital Medical College, has been appointed to the newly established chair of roentgenology. Dr. Vera Danschakoff, formerly of Moscow, has been promoted to be assistant professor of

anatomy and Dr. I. H. Goldberger, has been appointed special lecturer of child hygiene in the school for oral hygiene.

MR. ARTHUR C. WALTON, M.A. (Northwestern '15), M.A. (Harvard '16) has been made acting professor of biology in the chair made vacant by the death of Professor Umbach. Mr. Walton holds a Harvard traveling fellowship and had planned work in Sweden but was prevented by the war.

FRED G. ALLEN, of Erie, Pa., a graduate of the University of Toronto, has been appointed assistant professor in electrical engineering at Lafayette College to take the place left vacant by the resignation of E. D. Tanzer, who has become assistant professor of electrical engineering at the Georgia Institute of Technology.

EARLY in January Miss Margaret Heatley, instructor in botany at Wellesley College, sailed for South Africa to take charge of the botanical department in Huguenot College of Cape Colony during the absence on sabbatical grant of Dr. Bertha Stoneman. Miss Alice M. Ottley, who was absent on leave, has returned to Wellesley College to fill the vacancy in the botany department caused by Miss Heatley's absence.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE GEOMETRICAL MEAN AS A B. COLI INDEX

IT is always a beneficial means of grace for a scientist to wander into paths outside his own domain; such excursions often reveal too the lack of coordination between the various sciences, although happily there has been great progress within the past two decades in this respect. These remarks are evoked by a reading of the note by William Firth Wells: "The Geometrical Mean as a *B. Coli* Index" in SCIENCE for January 11.

The first impression gained is the lack of a clear presentation of the method. The notion of a geometric mean is purely mathematical, but it must be said that to a mathematician, even to one fairly conversant with the theory and methods of bacteriological analysis, the theory on which this method rests is not at all in evidence, save only perhaps in the remark that "the ordinary bacteriological dilution scale is in reality a logarithmic scale." It does not, however, follow necessarily that the most probable number of *B. coli* is the geometric mean as obtained by Mr. Wells. In support of this contention, see a thoroughly mathematical treatment of the whole question by M. H. McCrady,[1] of the laboratories of the board of health of the Province of Quebec; the formulas there derived show that the logarithmic function is more complicated than Mr. Wells perhaps has in mind. His experimental data may, on the other hand, show that his proposed method will serve well as a "first approximation."

The second impression coming from a study of the article is the feeling that this method merits a mathematical treatment. It seems to be essentially as follows: Five sets of twenty tubes each, containing portions of the sample in powers (not "multiples") of ten, are tested for the presence of gas, indicating the presence of *B. coli*. For the dilutions 10 c.c., 1 c.c., .1 c.c., .01 c.c., .001 c.c., graded with the scale numbers 0, 1, 2, 3, 4, respectively, the number of tubes showing presence of *B. coli* was 20 18, 8, 1, 0, respectively, the experiment having been extended from a dilution at which all tubes gave positive results to one in which no tube gave such a result. In going from the weakest dilution to the next higher there was a *gain* of one tube, next a gain of 7, then of 10, then of 2. The scale numbers, which appear to correspond to the logarithms of certain hypothetical most probable numbers of *B. coli* for the separate dilutions, are averaged with the foregoing gains used as weights, *i. e.*, 2, 10, 7, 1, 0; and the weighted mean thus found corresponds to the logarithm of the desired most probable average number of *B. coli*. In other words, the weighted geometric mean of the above-mentioned hypothetical numbers of *B. coli* is taken as the desired average.

An immediate consequence of the mathematics involved is that the same result is

[1] M. H. McCrady, "The Numerical Interpretation of Fermentation-Tube Results," *Journal of Infectious Diseases*, Vol. 17, No. 1, January, 1915, pp. 183–212.

always obtained by dividing the sum of all the positives except the highest by the highest, *e. g.*, $1/20\,(18 + 8 + 1 + 0) = 1.35$. That a mathematical treatment would improve and standardize the computation can be seen from the remark that a hasty study gives the following simpler result (subject to the doubt already expressed as to the validity of the theory): The aggregate per cent. of "positive" tubes gives the logarithm of the most probable average number of *B. coli* per 100 c.c., *e. g.*, $1/20\,(20 + 18 + 8 + 1 + 0) = 2.35$, and this is the logarithm of 224. This rule will explain, for example, why Mr. Wells's "reversion method" works, for it is the mathematical equivalent of the foregoing. A further implication is that the author would seem to be wrong in saying that the "percentage positive" (the aggregate percentage) gives the desired result for a test using a single dilution; to use a concrete example, 18 positives out of 20 at 1 c.c. together with 0 positives out of 20 at .1 c.c. should by any test be regarded as indicating a smaller number of *B. coli* than the 18 positives alone, yet the rule here commented on yields the same results for both.

It will be of undoubted value to have Mr. Wells's more complete presentation particularly of the experimental data which he mentions.

W. D. Cairns

Oberlin College,
Oberlin, Ohio

SOME DEFECTS IN OUR AGRICULTURAL INSTRUCTION

In the preface to the text-book on agricultural botany ("Traité de Botanique Agricole et Industrielle") by J. Vesque, professor of agricultural botany in the National Institute of Agronomy of France, the following criticism on the agricultural instruction then (1885) given in France occurs:

> In France the agricultural instruction attaches itself more and more to rearing of livestock. It is too much forgotten that the animals are nourished by the plants, or, if it is not forgotten, it is taken for granted that the culture of plants consists merely in the production of a maximum mass of vegetables. The nature of the plants, the species which populate our fields, the seeds confined to the soil are far from preoccupying the cultivator as much as the nature of the soil and the fertilizers employed. All the agricultural instruction may at this point be summed up in three words: Zootechny, agricultural chemistry and rural engineering. The plant, the initiative in all agricultural pursuits, is almost excluded. How many cultivators know the herbs of their farms, how many are capable of distinguishing the good from the bad? Liebig was certainly not wrong in accusing the students of the agricultural schools of knowing neither the seeds of the grasses nor the grasses themselves.

These remarks, describing the character of the agricultural instruction in France in 1885, fit the condition prevailing in many of our American agricultural colleges at the present day to a strange degree of exactness. The same neglect of the scientific knowledge of plants is present, not only in courses in which animal industry is the major subject, but even in such courses as agronomy and horticulture, which from their very nature should deal largely with plants. We find the botanical equipment of the average graduate very meager indeed. He has not infrequently been the recipient of long lecture courses on forage plants without possessing definite knowledge of the distinction between grasses and legumes; or he has studied ornamentals in his horticultural courses without enough training in botany to appreciate either the meaning of the description of a plant or the importance of its scientific name; or he may have spent considerable time in judging corn without having clearly in his mind to which family of plants the Indian corn belongs, or what characteristics distinguish it from the other members of its family. Such vague knowledge of plants is not uncommonly met with among graduates from agricultural colleges claiming thoroughness for their preparation.

No one will deny the right of agriculture to the title of a generous place in the higher education, based as it is on those natural sciences, in which our country claims its proudest distinction in its progress. It is also undoubtedly the intention of all these agricultural colleges,

due to the land grant act, to furnish this higher education, for the equipment of which they are liberally supported by the state and national means. The claims upon the preparation for entering these colleges are also about the same as that required by schools of the higher order, or the university class, that is high-school graduation, or its equivalent. But in spite of these advantages and the numerous special courses offered by nearly all these colleges, a great many of our graduates are suffering from the deficiencies complained of by Professor Vesque, thirty years ago in France.

In glancing over the catalogues of the courses of the agricultural instruction given in these colleges, one is struck by the multitude of optional courses, which are frequently restricted to very narrow specialties. The time allotted to one of these petty subjects is frequently as much as that given to the whole of the science of botany, which constitutes one of the main foundations of the entire structure of higher agricultural education.

In further examining these special courses, we shall find that many of them presuppose a careful preparation in botany which, however, has not been granted by the general curriculum. It is not infrequent that a student in some of these colleges is receiving lectures in plant breeding without previously having received any instruction, worth his while, either in morphology or taxonomy. An examination of the curriculum of many of our agricultural colleges seems to reveal the fact that there is too much specializing upon the superstructure before a safe foundation is laid. If the student be equipped with a fair general knowledge of botany, chemistry and physics, including physical chemistry, he may be trusted to develop the specialties of agriculture resting upon these as opportunity and occasions arise, but if the fundamentals be lacking, he will always remain uncertain and giddy.

H. Ness

Texas Experimental Station

PROFESSIONAL COURTESY

To the Editor of Science: We appreciate your courtesy in submitting to us the criticism concerning ethics involved in the publication of the article referred to by Professor Hart. We do not feel that a reply to the charges contained in his statement is necessary, further than to say that the work referred to was planned entirely by one of us (McCollum) and was carried out by Mr. Steenbock, according to the usual practise in experimental work. The detailed records of the time of extractions, filtrations, evaporations, etc., were published verbatim from notes copied by Mr. Steenbock for me as requested, and should, of course, correspond closely with his notebooks.

In a case of this kind where the veracity of one of the statements must be questioned by those who read this charge and our reply, nothing better can be done than to leave the public to judge for itself on the basis of the research records of all concerned as to the probable responsibility for the planning of this work.

E. V. McCollum,
N. Simmonds

SCIENTIFIC BOOKS

Societies of the Plains Indians. Anthropological Papers of the American Museum of Natural History. Volume XI. New York, 1916. Edited by Clark Wissler. Issued in 13 parts; C. Wissler, R. H. Lowie, P. E. Goddard, A. Skinner, J. R. Murie, contributors.

This volume probably does not represent the greatest undertaking in modern American ethnology: it does represent one of the most efficiently executed, and is therefore of interest as an example of the method to which the science has attained. In case the designation "science" seem as yet unearned, let us compromise on "study of uncivilized culture history."

There are still many students at the height of their activity who were trained in, and some who practise, the older ethnology: a discipline begot by an intrinsic interest in the phenomena of culture, but fathered and nourished by the doctrine of evolution after it had begun to transcend its proper biological

source; and leaning as heavily as unconsciously on a kind of crude lay psychology of the individual. So strong was the impress of the idea of an unfolding sequence inhering in phenomena themselves, in this earlier ethnology or self-styled "science of man," that the actual relations of its phenomena in time and space were rarely looked into systematically. In consequence, its causal factors were determined with equal randomness. The explanations of causality of which the evolutionary anthropology of a generation ago consisted, were hypothetical and plausible.

The element of time, easily recoverable, at least as regards its relative phases, in prehistory and most fields of archeology, can be only indirectly reached in ethnology proper, which deals with living peoples innocent of writing. Ordinarily, all that we have of them is a momentary cross section of the long stream of their customs. Obviously, the course of this channel can be reconstructed factively only through a detailed determination of the data in terms of some other element which may subsequently be converted into factors of time. This other element is that of space; or, as it is usually named in this connection, geography. Experience to date has revealed no other method, except the speculation, mystical or rationalizing, concealed or avowed, of the older workers.

The spatial factors were strongly appreciated by Ratzel and his school, though still partly in terms of formal physical geography. Chance, however, brought it that in this country a body of students less driven through their general social environment to attempt interpretation than their European colleagues, found themselves envisaged at arms' length, as it were, by a mass of first-hand and living ethnological data. Once these were tasted, they proved emotionally palatable to many minds; with the result that materials were gradually accumulated on a really enormous and unprecedented scale.

It is curious how slowly the realization of this opportunity dawned. Ethnology was practised in this country fifty and seventy-five years ago, and if the students were less in number, they were, man for man, probably more illustrious, as the names of Hale, Gallatin, Morgan, Brinton, and Powell attest. These eminent men truly conducted researches, where many a successor has done little more than assemble material. But the personal contact of all of these pioneers with the Indians at their door was limited, and several disdained it wholly. The explorer, the traveler, the missionary, the military leader, sometimes the compiling historian or instituting official of civilization, were their purveyors of substance. Only slowly was it felt that as good and far better information could be got by the inquirer whose business was ethnic knowledge than by the voyager or resident whose purpose was incidental, and that such acquisition, instead of being an arduous preliminary task, was in itself a grateful pleasure. Much of the old native life long resisted the brunt of our civilization; an infinitude more lay immediately below the surface. The Indian, far from impeding serious inquiry, in most cases was only interested in facilitating it. An enormous tribal diversity lent the color of variety to every increasing endeavor. And, as the spread of the frontier and the education of the Indian tended to obliterate the continuance of native custom, they also rendered access to the people, and intelligent communication with them, easier, less expensive, and more profitable. To-day, the generation of American ethnologists is reared in field studies. Its novices take work on an Indian reservation for granted as the first step on the professional ladder. It is true that acquisition for a time so far outstripped utilization that the reproach was sometimes leveled from transatlantic quarters that purpose had been forgotten and direction lost. But it is equally important to realize that no equally extensive and continuous body of detailed ethnic data has ever been accumulated on the primitive people of any other area as on those of the United States, Canada, and Alaska.

In time, the mere mass of material forced its classification; and its arrangement by types

proved to be essentially an arrangement in space also, in practically every instance. The factor of distribution became as inescapable as in biology, and was recognized as far more momentous than had hitherto been the case in the depiction of non-literary peoples. From distributions to diffusions was only a step that forced itself on the attention; in technical language, the "culture area" began to be replaced by the "culture center" as a working tool. And any diffusion already sets us in time as well as space; with the results that ethnology is beginning to be back at the sequences with which it commenced—but now painstakingly arrived at and laboriously solidified instead of speculatively leaped at.

An example is the present volume on "Societies of the Plains Indians." The older ethnologist vaulted the gap between a tribe in Mexico and one in Alaska, or slipped between the beginning and end of a sentence from ancient Greece to modern Australia as if his bridge of fancy were one of traveled fact; and his next colleague—there were no collaborators—rambled or flew where he listed. The student of to-day begins by associating himself with colleagues. They plan an inquiry, not into a universal phase of human activity, nor of the American Indian, but of the formal religious associations of one group only of North Americans, the closely similar tribes of the Plains. They are nine years securing their material and four presenting and analyzing it; and it bulks to a thousand pages. This may seem a rioting welter of technicality. The laymen would prefer a handy pocket volume that told him incisively who the Indian was, whence and how he came, the consistent scheme of his society, the nature of his religion, and how both originated. There is no answer, nor attempt to answer, even one of these quesetions in the present work. Its thirteen parts describe the associational organization of the religion of sixteen tribes, or, with those on which adequate information happened previously to be extant, all of any importance within the cultural limits of the Plains. The type of each tribal religion is defined; interrelations elucidated; and the two concluding comparative sections by Drs. Wissler and Lowie finally settle into pure history in the most rigid sense of the term.

Thus, in his "General Discussion of Shamanistic and Dancing Societies," Dr. Wissler gives a family tree of the Iruska ceremony and associations connected with it. He succeeds in tracing this to a Dakota rite known as the Heyoka, which, with the addition of certain Omaha features, was taken by the Pawnee and worked into the Iruska proper. This traveled back to the Omaha and from them to the Dakota, who, by adding a new and vigorous series of songs, popularized the ceremony as the Grass Dance, and gave it to a long array of tribes. One of these, the Potawotomi, some twenty years later, added still farther to the religious "complex," and, as the Dream Dance, passed it on to another group of tribes. These were marginal or exterior to the Plains, distinct in their religious assumptions from the Plains tribes proper, and obviously took up the made over form of the ceremony because it was made over. A number of peoples accepted the "Iruska Trait-Complex," as the author calls it, twice in their and its careers; the Iowa even received and followed it three times, as Iruska proper, Grass Dance, and Dream Dance. It is of interest that as a rule the natives were well aware of the filial relationship between an earlier and later form of the cult.

It is clear that what we have here is history as historical as any following out of the origins and growth of Christianity or the Papacy or Parliamentary government, but reconstructed by circumstantial evidence derived from materials furnished by a group of peoples without annals, documents, or a scrap of writing. It is also evident, while the world will never be deeply moved by the Iruska cult or by the activities of the Pawnee in the nineteenth century, that studies such as this are uncovering principles of broad applicability—principles of a psychology that is truly social, and that in a greater or less degree must ultimately be met and recognized by every historian or analyst of human civilization.

Similarly, Dr. Lowie in his comparative study of the Age Societies—religious bodies grouped or graded according to the age of their members—although dealing with a set of institutions much older than the Iruska ceremonies, in fact far antedating the advent of the Caucasian in the region, establishes that the age-grade societies are an outgrowth of a system of non-graded societies still prevailing among the majority of Plains tribes; that the grading originated among either the Mandan or Hidatsa; and that the scheme spread from them respectively to the Arapaho and Gros Ventre and to the Blackfoot at a time when these peoples were in closer contact with the Mandan-Hidatsa than has been the case within the historic period. Again, the outcome of the investigation is a specifically founded reconstruction and a definite tracing of the sequence of events.

Dr. Lowie concludes by testing against these positive determinations a theory devised according to the old method by Schurtz, purporting to discern age societies as an institution arising spontaneously and necessarily at a certain stage of development of human civilization. As a wholly abstract speculation, the Schurtz hypothesis is scarcely assailable and equally useless. Matched against the analyzed facts in the Plains of North America, in Melanesia, and in East Africa, it breaks down and dissolves utterly. In fact Dr. Lowie shows convincingly that the age societies in these regions are not identical nor even parallel but represent diverse causes, diverse characters, and diverse sequences. Their uniformity and the supposed "laws" governing them are in the assumptions of the theorizer, not in the events.

This, it may be added, is the type of finding that invariably emerges when a critical and inductive examination is made of any of the smooth explanations that were the crop of the anthropology of half a century ago, and which are still the inviolable stock in trade of the anthropology dealt out in the Sunday newspapers, the drawing room, the books on "social evolution" and the mass of semi-scientific, unscientific, and pseudo-scientific literature that sets solution before inquiry. The matriarchate, the priority of female lineage, the antecedence of the clan to the family, promiscuity and group marriage, the fundamentality of the totem idea, the mana concept as the basis of religion, the development of alphabets from pictures, or geometric ornament from symbols, strange vestigial survivals generally—all these delightfully exotic, fascinatingly romantic, and often alluringly shocking views that have given anthropology most of its broad appeal, have their glitter crumble into dust as soon as critical method is applied to them. To most ethnologists of his own school, Dr. Lowie's elaborate demolition of the Schurtz speculation may seem unnecessary. Its wider significance is as a symptom of the growing conversion of anthropology from the toy of fanciful half scholarship to a product of scientific method.

Finally, too great credit can hardly be bestowed on the institutional side upon the American Museum of Natural History, its anthropological department, and Dr. Wissler, for the clean, business-like, and effective manner in which the undertaking represented in this volume was planned, carried through, and concluded. Without announcement or formal flourish an important scheme was formulated, put into operation year after year, systematically but never unbendingly adhered to, with cumulative results, and concretely accomplished through the cooperating efforts of a staff of five participating students, one of them a member of the native race whose institutions formed the subject of the inquiry. The parts of the volume were published promptly, the summaries undelayed, the typography, illustrations, and index are of the best. The record is one with which the Museum may well be content administratively as well as scientifically.

A. L. Kroeber

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The eleventh number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

A necessary and sufficient Condition for the Existence of a Stieltjes integral: GILBERT AMES BLISS, Department of Mathematics, University of Chicago.

Transformations of Applicable Conjugate Nets of Curves on Surfaces: Luther Pfahler Eisenhart, Department of Mathematics, Princeton University.

On Bilinear and N-Linear Functionals: Charles Albert Fischer, Department of Mathematics, Columbia University.

The Crystal Structure of Chalcopyrite Determined by X Rays: Charles L. Burdick and James H. Ellis, Chemical Laboratories, Throop College of Technology. Chalcopyrite belongs to the tetragonal system of crystals, few of which have been examined for structure. The lattice is of the face-centered type.

The Isostatic Subsidence of Volcanic Islands: W. M. Davis, Department of Geology and Geography, Harvard University. Darwin's primary theory of coral reefs holds good, although his supplementary theory of broad ocean-floor subsidence needs modification.

On the Deformation of an N-Cell: Oswald Veblen, Department of Mathematics, Princeton University.

A Theorem on Series of Orthogonal Functions with an Application to Sturm-Liouville Series: George D. Birkhoff, Department of Mathematics, Harvard University.

Low-Temperature Formation of Alkaline Feldspars in Limestone: Reginald A. Daly, Department of Geology and Geography, Harvard University. A review of recent European literature and a discussion of American Rocky Mountain dolomite.

The Interferometry of Small Angles, etc. Methods by Direct and Reversed Superposed Spectra: Carl Barus, Department of Physics, Brown University.

The twelfth number of Volume 8 contains the following articles:

Incompatibility of Mutant Races in Drosophila: C. W. Metz and C. B. Bridges, Carnegie Station for Experimental Evolution, and Columbia University. The evidence from two cases of incompatibility in laboratory cultures taken with evidence from apparently mutant forms and incompatible varieties of nature tends to remove a serious objection to the mutation hypothesis and emphasizes the possible evolutionary importance of mutations involving incompatibility.

Absorption Effects in the Spiral Nebulæ: Heber D. Curtis, Lick Observatory, University of California. Negatives of spiral nebulæ obtained with the Crossley Reflector show that the phenomenon of dark lanes caused by occulting or absorbing matter is much more frequent than has been supposed. The results may bear directly on the explanation of the peculiar grouping of the spirals.

The Synergetic Action of Electrolytes: Oran L. Raber, Laboratory of Plant Physiology, Harvard University. Synergy is the opposite of antagonism; although antagonism is frequently reported, few cases of synergy have been noted.

Appetites and Aversions as Constituents of Instincts: Wallace Craig, University of Maine, Orono. Although innate chain reflexes constitute a considerable part of the equipment of doves, few or none of their instincts are mere chain reflexes. On the contrary each instinct involves an element of appetite, or of aversion, or both.

Rapid Respiration after Death: A. R. C. Haas, Laboratory of Plant Phsiology, Harvard University. The respiration of *Laminaria* may be much greater after death than in the normal condition.

The Means of Locomotion in Planarians: Caroline E. Stringer, Zoological Laboratory, Radcliffe College. The locomotion is essentially a muscular act in which the cilia play no necessary part.

Diurnal Changes in the Sea at Tortugas, Florida: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington.

Note on Interferometer Methods of Measuring the Elastics of Small Bodies: Carl Barus, Department of Physics, Brown University.

Sublacustrine Glacial Erosion in Montana: W. M. Davis, Department of Geology and Geography, Harvard University. Clark fork branch-glacier seems to have done its visible erosive work on the valley-side spurs—and presumably a considerable amount of invisible work on the valley bottom—although it must have been wholly submerged in Lake Missoula for two or three score, if not for four score miles.

The Effect of Stretching on the Rate of Conduction in the Neuro-Muscular Network in Cassiopea: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington. Apparently stretching the nerve does not change the rate.

A Criticism of the Evidence for the Mutation Theory of De Vries from the Behavior of Species of Oenothera in Crosses and in Selfed Lines: Bradley Moore Davis, Department of Botany, University of Pennsylvania. Although most of the genetical work on œnotheras has not been interpreted in Mendelian notation, there is clear evidence of order in the results in inbreeding and crossing: the difficulty has been to discover and to isolate simple material in the confusion of mixed and impure forms of these plants.

The Spectra of Isotopes and the Vibration of Electrons in the Atom: William D. Harkins and Lester Aronberg, Kent Chemical Laboratory and Ryerson Physical Laboratory, University of Chicago. The spectra of isotopes have previously been reported as identical within the errors of measure. The authors find, however, a slight difference. The wavelength of uranio-lead was very slightly longer than that of the ordinary lead.

The Effect of Oxygen Tension on the Metabolism of Cassiopea: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington.

National Research Council: Scientific Publications from Germany; Report of the Geology and Paleontology Committee; First Report of Committee on Zoology; The Scope and Work of the Botanical Raw Products Committee; Meetings of the Executive Committee.

List of Publications of the National Academy of Sciences.

Report of the Autumn Meeting: Business Session; Scientific Sessions.

We may summarize the articles in Volume 3 of the *Proceedings* as follows: Mathematics, 13; Astronomy, 17; Physics and Engineering, 32; Chemistry, 12; Agriculture, 4; Geology and Paleontology, including Oceanography, Mineralogy and Petrology, 18; Botany, 5 (see also Genetics); Zoology, including General Biology, 27 (see also Genetics); Genetics, 11; Physiology and Pathology, 18; Anthropology and Psychology, 5; a total of 162 articles.

The division of these articles between members of the academy and non-members is 49 and 113 respectively.

The list of institutions which have contributed three or more articles is as follows: Carnegie Institution, 32, divided as follows: Solar Observatory 13, Marine Biology 7, Station for Experimental Evolution 6, Tortugas Laboratory 5, Geophysical Laboratory 1; Harvard University 26; Brown University 9; Yale University 7; University of Chicago 6; University of Illinois 5; Princeton University 5; Rockefeller Institute for Medical Research 4; U. S. Department of Agriculture 4; Johns Hopkins University 4; University of Virginia 4; General Electric Company 4; American Museum of Natural History 3; Columbia University 3.

Edwin Bidwell Wilson
Mass. Institute of Technology,
Cambridge, Mass.

SPECIAL ARTICLES

RESULTS OF CORN DISEASE INVESTIGATIONS

A preliminary summary of three years' investigations of certain little understood corn diseases made in Illinois and Indiana, includes some interesting facts which the writers desire to present at this time. This study has been conducted both in the field and in the laboratory. A more complete statement of the results will be published in the near future.

These studies are all based on the ear-to-row test. Dent corn only was used in these tests. They are not conclusive, but indicate the lines of attack, and this statement is presented at this time to call attention to the fundamental relation of these investigations to seed selection and the germination test. Approximately a hundred and fifty readings have been made on the mother-ear, seed, seedlings, and field performance of each of the ears. No ears are referred to herein which did not have a hundred per cent. germination record. The germination records are based on twenty kernels from each ear. The report of this year's work is corroborated by the results of the two previous years.

Some of the most important results of the experiments are:

(*a*) That barren stalks and stalks bearing only nubbins seem to be correlated with certain pathologic conditions in the plants. There is also a correlation between certain types of seedlings grown on a neutral-base germinator and the number of barren stalks that grow from the seed planted from the same ears.

(*b*) That in fifteen rows of corn grown this season from ears which present this pathologic condition in the seedlings, there were 15.2 per cent. of the plants barren, and 6.2 per cent. of the stalks bore nubbins only. In these rows 15.2 per cent. of the stalks were down by the end of the growing season. In fifteen rows of corn grown from ears not having seedlings which showed this pathologic condition, 6.3 per cent. of the stalks were barren, and 3.4 per cent. bore nubbins only. In these rows 3.1 per cent. of the stalks were down at the end of the growing season.

The computed difference in yield between these two series of rows was 22.6 bushels per acre. The rows were distributed throughout the test plot, the high-yielding and diseased rows alternating.

(*c*) That this pathologic seedling type is developed both on the neutral-base germinator and in sterile agar flask cultures.

(*d*) That surface sterilized seeds harbor bacteria and species of *Fusarium*. The bacteria cause a rotting of the seedling root tips in the sterile flask cultures. This rotting of the roots of the seedlings is the germination characteristic of the ears of corn which develop the greatest numbers of barren and down stalks in the field.

(*e*) By controlling fertilization by hand pollinating ears of apparently disease free plants with pollen from similar plants, the amount of barrenness in the rows from these ears was reduced to less than 1.5 per cent., and with but 1.2 per cent. down-stalks at the end of the growing season.

(*f*) All kernels from the same infested ear do not harbor pathogenic organisms within them. Neither is the rate of seedling development usually referred to as "vitality," a criterion for assuming freedom from infestation of the seed by bacteria and species of *Fusarium*. The rate of seedling development on the germinator is not indicative of the yield possibilities of that seed ear.

G. N. Hoffer,
Purdue University, LaFayette, Ind.
J. R. Holbert,
Funk Seed Co., Bloomington, Ill.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION F (ZOOLOGY)

The Convocation Week meetings of Section F (Zoology) of the American Association for the Advancement of Science were held in conjunction with those of the American Society of Naturalists at Pittsburgh, Pa., December 31, 1917, and January first, 1918. The meetings of Monday, December 31, were in charge of the officers of Section F and were presided over by Professor Herbert Osborn, professor of zoology in the Ohio State University and vice-president of Section F. In the absence of the secretary of the Section, Professor W. M. Smallwood, of Syracuse University, acted as temporary secretary.

At the business meeting of the Section, Professor L. B. Walton, of Kenyon College, was reelected member of the council; Professor V. E. Shelford, of the University of Illinois, was chosen member of the sectional committee for five years; Professor C. H. Eigenmann, of Indiana University, was elected member of the general committee.

At the meeting of the sectional committees Professor William Patten, of Dartmouth College, was nominated as vice-president of the section for the ensuing year, and Professor Herbert V. Neal, of Tufts College, was reelected secretary of the Section for five years.

The following resolution, presented by Professor H. B. Ward, was unanimously adopted by the Section:

In the opinion of Section F it is important that in any plans formulated or arranged by the American Association for the Advancement of Science looking toward the organization and development of national or international bibliographic projects, the existing international bibliographic undertaking for zoology, *i. e.*, the Concilium Bibliographicum in Zurich, long approved by this Association and in part supported by numerous grants from its funds, be kept definitely in mind and included in any plan for bibliographic work presented for consideration by the special committee of the council.

The Section voted to recommend that the association make a grant of $1,000 to Professor C. H. Eigenmann, of Indiana University, for the study of South American fishes.

Owing to the absence of Professor G. H. Parker, of Harvard University, the address of the retiring vice-president was not given. The address—upon "Some underlying principles in the structure of the nervous system" has appeared in SCIENCE (Feb. 15). The following papers were read:

1. *Some pathological phenomena following inhalation of chlorine gas:* H. R. HUNT AND W. H. SCHULTZ, West Virginia University.

The lungs of animals killed with chlorine gas show the following characters differing from those found in normal lungs:

1. Depending upon time of exposure and upon concentration of gas inhaled, chlorine gas causes an abnormal distribution of blood and fluid in the lungs. In more or less localized areas of lobules, there are varying degrees of congestion of arterioles. This may be associated with edema and hemorrhage causing hepatization.

2. Histological study of hepaticized areas shows the following pathological conditions:

(*a*) The arterioles of gassed lungs are filled with blood, often under such tension as to render the elastica interna nearly free from folding. There seems to be a concentration of cellular elements and a diminution of fluid content in the arterioles.

(*b*) The media and adventitia of congested arteries are edomatous causing considerable thickening of these layers.

(*c*) The capillaries frequently show small islands of corpuscles which apparently have been caught and retained in what appear to be constricted vessels and the arterioles supplying these vessels are greatly congested.

(*d*) The nuclear membrane of "fetal cells" seems slightly irregular. It stains more deeply with hematoxylin, the nuclear material appears clumped into larger granules and the cytoplasm is less plump than normally. The latter takes on a bluish tinge with hematoxylin. Further study of the respiratory cells is necessary, but the indications are that chlorine and hypochlorous acid so alter fetal and respiratory cells of alveoli and the endothelium of capillaries that not only is circulation of corpuscles interfered with, but respiratory processes of alveolar tissue are retarded or prevented.

(*e*) The alveoli of hepaticized areas contain fluid poor in cellular elements. Frequently much fluid pours into alveolar passages, extending to terminal bronchi and larger subdivisions of the bronchial tree. Usually, however, in these larger air passages the fluid is mixed with air and is frothy. Hence a freshly cut surface of gassed lung, though apparently dry, when gently squeezed is made to froth from the end of air passages. In the living animal the abundance of fluid in these air passages is evidenced by a pronounced râle during respiratory movements.

2. *A comparison of the responses of representatives of different phyla from the protozoa to the mammalia, in gradients of environmental factors with particular reference to their method of reaction:* V. E. SHELFORD, University of Illinois.

The "general interest" session of Monday afternoon took the form of a symposium on the "Contributions of zoology to human welfare." Papers were read by Dr. L. O. Howard and Professor H. B. Ward. The paper of Dr. Hugh M. Smith, commissioner of fisheries, who was unable to attend the meeting, was read by the secretary. These papers together with one by Professor M. A. Bigelow, who was unable to be present, will appear elsewhere in SCIENCE.

The meetings of Tuesday, January 1, were in charge of the officers of The American Society of Naturalists and have been reported in SCIENCE by the secretary of that society, Professor Bradley M. Davis.

HERBERT V. NEAL,
Secretary

SCIENCE

FRIDAY, MARCH 15, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

DR. FRANKLIN P. MALL: AN APPRECIATION

THE death of Doctor Mall is so recent and my grief for his loss so fresh that I find myself reflecting on the fruitful and delightful memories of our past association instead of writing out my impressions of his unusual personality.

Doctor Mall came to Johns Hopkins in the late summer of 1893 and just before the medical school opened its doors to the first class of students in the autumn. It was there that we met. I recall vividly my excitement and nervousness when the rumor was circulated about the old pathological building that Mall had arrived. His name had been a tradition among the small group in the department of pathology. A few years earlier, before the hospital had been opened to patients, he had come to the laboratory and as fellow in pathology had performed a miracle of interesting and important studies on the connective tissue foundations of the organs. Fellows in pathology there had been since his time, but no one whose memory was glorified as Mall's had been. We had so often heard him and his work spoken of by Doctor Welch, Doctor Halsted, and others, including the indispensable Schultz, who was for many years presiding genius over the technical and janitorial services of the laboratories and whose commendation carried with us such great weight, that I pictured Mall as quite different from what in actual life he proved to be.

One's fancy—my fancy surely was so—when young is apt to produce its own pictures. In my fanciful portrait of Mall I represented him as large, absorbed, and

rather austere. Never was a fancy more completely and happily shattered. I can just remember our meeting; those who knew Mall well will never forget how engagingly he smiled. It was with one of the best of his smiles that he greeted me.

That event was the auspicious beginning of a warm friendship which never wavered until his death. During the first period of half a dozen years we were in almost daily contact. Later, and after 1900, when I left the medical school to enter the University of Pennsylvania, our meetings were at first not infrequent. I shall never cease to regret the increasing intervals between them which followed my removal to the Rockefeller Institute in New York. Increasing responsibilities and enlarging duties play havoc with one's life, and I feel that I suffered a grievous and now irremediable loss in permitting those circumstances to cut me off to the extent it seemed inevitable they should from association with Mall. To a certain extent, letters took the place of personal contact. Thus I kept more or less in touch with the workings of his restless and constructive mind.

It probably will strike few except his very intimate friends that Mall was by temperament a reformer. He was an uncompromising democrat and hence entertained the firmest belief in liberty in its true and proper sense. Out of this intensity of conviction arose the views expressed in conversation more frequently but not more forcibly than in his addresses, on full opportunity and freedom in university education, both in its pre-graduate and post-graduate aspects. His comprehending and incisive mind was the first, I believe, to appreciate and afterwards to propound that the best of medical educational institutions were half-hearted affairs. That part of the institutions which a quarter of a century earlier had been the weakest—the laboratory branches namely—had been immeasurably strengthened in that short period, during which the previously stronger part—namely the clinical branches—had progressed relatively little. The balance could be struck and must be, even though in the process the old system were, if need be, completely shattered, as much shattered indeed as had been the earlier hybrid combined laboratory and clinical chairs. Out of this conception which Mall propounded, I am almost inclined to say preached to us persistently, arose the present movement, ever gaining force and strength until it has now become almost irresistible in favor of full-time clinical professorships.

It is very interesting to consider just here the extent to which he used others, converts or disciples as they may be called, to diffuse more broadly his reforming ideas. One would search Mall's miscellaneous papers, of which indeed there are notably few, in vain for an exhaustive presentation of the case for the full-time clinical plan. The wide dissemination of the idea by the printed page was left to others, while he maintained the high level of conviction in those coming under his immediate influence by an irresistible fund of logical exposition.

In his delightful essay on his master, Wilhelm His, Mall reveals his attitude toward higher education in its various complex aspects. I wonder how many returned foreign students have kept up an intimate correspondence with a revered teacher extending over a long period of time, like that disclosed by Mall in this essay. The extracts from his letters there published show how well the older man comprehended the younger, as the spirit and substance of the essay shows how the younger man admired and appreciated

the older. There is no doubt that His perceived in Mall rare personal and mental qualities, as he confides to him not only the subjects and trend of work, but his larger aspiration in the wide domain of anatomical research. In the light of the relation there revealed one can surmise the satisfaction and joy with which His, had he lived, would have welcomed the establishment of the Institute of Embryology with Mall as the first director.

In my task of presenting a fragment of the personality of Mall as apparent to his intimate friends and associates, I find myself embarrassed by the many memories that crowd my mind. It is not easy to select episodes. I love myself to think of the period during which he lived, as did the medical officers, in the Johns Hopkins Hospital, for then we were almost constantly together. The small, older group of men—older, that is, than the internes—saw much of one another. Mall, Frank Smith, Thayer, Barker, and I met always at dinner, frequently at breakfast and luncheon, at the small table at the head of the room. There was lively conversation and much variety of theme; and not a little good cheer. A small photographic print still exists which pictures the group; it is chiefly notable for the good likeness of Mall which it presents, showing him as it does in one of his happiest moods.

Mall returned to Baltimore as the first professor of anatomy of the new medical school. The physical conditions surrounding the launching of the medical school were so simple as to be almost austere. Aside from the hospital—a model of completeness at the time—the plan for housing the new departments of the school we should now regard as meager in the extreme. I sometimes think that it may be well to recall from time to time the simple beginnings out of which the great institution of the Johns Hopkins Medical School arose. The only additions made to the hospital buildings to accommodate the departments of anatomy, physiology, and physiological chemistry and pharmacology, were two stories added to the original small pathological building erected as a mortuary for the hospital and already housing the entire pathological department. It was in the upper, or fourth story, of that enlarged building that the complex department of anatomy took origin.

Some one else, who traces the growth of anatomy at the medical school, can tell better than I can how Mall adapted the limited space and facilities at his command to the teaching of anatomy, histology, and embryology, and to the conduct of research. There was no actual break in the continuity of his own investigations, and very soon after the medical classes were taken in he began to produce the new work which in a steady and increasing stream has come out of the anatomical department.

There were not a few obstacles to be overcome in getting the students' work properly started. I recall the shifts he was obliged to make to bridge over the gaps in dissecting until human cadavers became available. This period was for Mall, in many ways, an anxious one. But it was not long before this particular obstacle was overcome, and because of the improvements which he introduced in the preservation of human cadavers, his laboratory soon became the custodian of all the anatomical material employed for dissection and surgical instruction throughout the city.

The kind of teaching which Mall gave to his students has been described; there was no lecturing in his curriculum. He had almost a horror of lectures in anatomy; the idea collided with his fundamental

conception of how such a practical subject is to be acquired. In his views there was one road only to that goal. The student must teach himself in order to learn. Hence there were provided the objects to be dissected, text-books, atlases, models, and time, with a sufficiency but no excess of instructors or guides. He saw no virtue in exhibiting and describing a predissected part, provided the students were given opportunity to dissect for themselves. That this principle is sound no one will, I think, now deny. That its operation has produced a remarkably large number of superior, independent, and broad anatomists, the history of his department amply shows.

But a confusion of method and man is often made with disastrous consequences. It is easy to imagine this mode of teaching anatomy adopted widely without yielding the results which Mall obtained. To put the method into effect would doubtless represent a great advance over the old system, but without a strong, able teacher and guide, such as Mall was, the phenomenal results which he achieved would not be attained. In other words, he was a sound innovator because he was a strong man. He was a successful leader in anatomy because he was learned and original. He has left a rich heritage to science through his own labors and those of his pupils, because to all his other qualities he added the rare ones of wisdom, kindness and generosity.

Our proximity in the pathological building brought us into frequent association. In the early days of the medical school, Mall often attended the autopsies, many of which I performed. His active interest in the pathological phenomena continued throughout his life, in part possibly as the result of the year spent as fellow in pathology under Doctor Welch. But in fact he did not disassociate, as is often erroneously done, facts of pathology from those of anatomy. Being naturally inquisitive in regard to the relation of cause and effect in respect to the unit forms of organs, he was also prone to inquire into the effects of causes in their nature pathological.

At about the period when Mall was studying the lobular unit of the liver I was induced to attempt the application of some of the methods he worked out to cirrhosis of that organ—a mere illustration of the way in which two related departments through him were made to react on each other.

I imagine that few who knew Mall even quite well realize with what intensity of absorption and application he would work at a problem once he had gripped it, as one might say. In temperament he was naturally reflective. Hence there occurred periods during which he appeared to be doing little in his laboratory. At such times he would become possessed with the impulse to roam about the building or out into the city or into the adjacent country. It was remarkable that when under the influence of those moods he did not seek solitude so much as another form of activity. I was not infrequently taken away by him for a stroll through East Baltimore, and on these expeditions I acquired quite a knowledge of that part of the city. They were in many ways extremely interesting occasions, for during them he often talked his best and sketched advanced ideas on educational and other reforms, as well as on problems of research. I think Mall never dreamt idly. He was possessed of a romantic imagination, but it was both controlled and constructive. To not a few who did not understand him well his ideas sometimes sounded extreme, but they invariably rested on real foundations,

as is now evident since so many of them have been carried into practical affairs.

At other times he worked out problems in his laboratory with consuming intensity. It would seem as if while under what I have called the spell of his reflective mood, a problem would formulate itself more definitely, or some barring obstacle give way to a revealed point of view. However that may be, my notion was that the periods of reflection were signs that he would attack a new or solve an old problem; and I always looked for new ideas and accomplishments when the mood changed.

If I have at all succeeded in revealing Doctor Mall as he appeared to me, then I have presented to you a complex personality. The remarkable thing is the way in which all the pronounced qualities that characterized him were fused into a simple, harmonious, kind and lovable individuality. I have referred already to Mall's democratic spirit. He was an intense lover and active exponent of liberty. His belief and confidence in freedom extended far beyond the confines of the university and laboratory, and into the world of politics and government. Freedom within the university he held as the first condition of the successful struggle of the forces of light over superstition and darkness. Within the walls of his laboratory the fullest liberty prevailed. Once outside the realm of the prescribed task for training, each man followed the bent of his own talents and tastes. However, his principles as well as his practise sharply differentiated between liberty and license; hence the rise under him of a group of strong, independent, but sound teachers and investigators. Mall would probably have combated the suggestion that he produced a school of anatomists, using the term in its usual significance. He would probably have insisted that he merely continued in America the system which he pursued or saw in force in Switzerland and Germany. But I believe rather that he made such definite contributions to the higher education and training of anatomists, and produced in, alas! a few brief years so large a number of varied and capable teachers and investigators, as to mark a new era in the history of higher educational endeavor.

I said that his deep convictions of freedom carried him into the wider domain of social liberty. Mall never propagandized on this subject. He however felt intensely about it. It is noteworthy that with all the admiration for the freedom of migration from university to university and the wide election of subjects and ideas in the German university, to the social and political conditions of that country he was antipathetic. To so strong a "democrat," to use that term in its wider and better significance, a studied paternalism and imperialistic tendency were deeply unsympathetic.

Mall's sincerity, self-effacement, and never-failing consideration were at the root of his noble qualities and made companionship with him a rare privilege. I have already spoken of my own good fortune in possessing in some degree his intimate friendship. It is a rare possession indeed and one to be cherished. But I owe him also an educational impress, none the less valuable because of its subtle nature. I am of the opinion that his pupils were influenced by this unusual quality which because of its elusiveness seems an emanation—so little was it given off or received with immediate conscious perception.

Mall was absorbed in ideas. They formed the substance of his serious talk, but he was by no means a stranger to the lighter side of human relations, for he possessed a gentle and engaging humor

which might even, when provoked, become a little biting. It took time and some skill to penetrate an outer film of reserve which arose from innate modesty and shyness, but once beneath that protective covering, one readily discovered in him a simple, idealistic and gifted person of many sides, possessed of an almost miraculous power to stimulate students to put forth their best efforts. His memory and example will long survive in the achievements of his students and associates, in the broad ideas which he disseminated, and in the admiration and affection which he inspired.

SIMON FLEXNER

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

FRANKLIN PAINE MALL: A REVIEW OF HIS SCIENTIFIC ACHIEVEMENT[1]

To those who are familiar with the history of medicine in this country, it is a matter of common knowledge that at the time Dr. Mall began his career, thirty years ago, anatomy in America had no scientific standing—a mere tool of surgery with but a single method, that of dissection. He left it where it must be in any community where medicine is progressive, one of its greatest sciences. He left it richly endowed with technical methods, a science so truly fundamental that workers in every other branch of medicine are constantly and increasingly returning to it, both for methods and for results. The vision of this change must have been his while he was yet a student for he wrote in one of his letters:

> My aim is to make scientific medicine a life work. If opportunities present, *I will.* This has been my plan ever since I left America and not until of late (since having received encouragement) have I expressed myself. I shall no doubt meet many stumbling blocks, but they are anticipated.

Sweeping aside the traditions of the dissecting room, he first created conditions under which this change could develop, and then devoted himself to scientific achievement and to the type of teaching in which he was profoundly interested. It was one of his oft-repeated maxims that the best and perhaps the only great way to teach is by example. With the ideal of scientific work as his goal, he has left us an example so rich in ideas, so varied in technical methods and so representative of the range of anatomy and embryology, that a study of his work is both an inspiration and an education.

His first undertaking in the field of research serves well to illustrate his independence of thought which, to those who knew him, was most striking. During the winter of 1885 he began his scientific work under His at Leipzig, who gave to him a problem connected with the gill-arches in the chick. In this study he came to the conclusion, now generally held, that the thymus arises from the endoderm of the pharynx, notwithstanding the fact that His held the view that it came from ectoderm. This work was given to His as Dr. Mall was leaving for Baltimore and was accepted for publication. In the next number of the journal of which His was editor, there appeared a second communication from the latter, strengthening his own point of view, but announcing that a different opinion would be published by one of his pupils in the next number. When Dr. Mall's article appeared, it was with a damaging footnote by His, to the effect that the independent character of the results was obvious. Two years later His restudied the region in a human embryo and found that Dr. Mall's conclusions were correct. He gave due acknowledgment of this in an open letter to

[1] Address given at a meeting in memory of Franklin Paine Mall held at the Johns Hopkins University, February 3, 1918.

Dr. Mall in the same journal, in which he states frankly, "Sie haben gegen mich Recht." This letter cemented a lifelong friendship, as can be readily seen from correspondence accompanying Dr. Mall's article on "An Estimate of the Work of His."

During the winter of 1885, His suggested that Dr. Mall work under the great physiologist, Ludwig. As Ludwig's laboratory was always full, the opportunity was slow in coming; indeed, as Dr. Mall wrote home, he was leaving Leipzig with no hope; his trunk was even on the way to the station when the letter came that the opportunity he so much desired was his. So great was the influence of Ludwig over his mind, character and future work, that it is impossible to overestimate it. He himself summed it up in these words: "To that master I owe much—all." Ludwig assigned to him the study of the villus of the intestine. His first impression of his new problem, as gathered from one of his letters home, was that here was a subject which had occupied the minds of the greatest anatomists of the past century. Repeatedly throughout Dr. Mall's writings there is to be found that expression of regard for the work of great minds. Widely read in his own subject, it was of the works which have lived that he made a profound study.

In Ludwig's laboratory Dr. Mall learned the methods of injecting blood-vessels and lymphatics, and his studies on the vascular system of the intestine and stomach are familiar to every student of medicine. Under the influence of Ludwig, his work was characterized by a very strong physiological bent. Indeed it may be said that his work was physiology in the hands of one with an intense interest in structure.

In some of the foreign universities it was the custom for a new incumbent of a chair to deliver an address giving, as it were, a "prophecy" or a "program" of his future work. Such a program was the famous address of His on accepting a chair in the Swiss University of Basel. In some such way the article of Dr. Mall on the stomach, published in the first volume of the Johns Hopkins Hospital Report, gives his program of the way he proposed to study anatomy. This paper lays a foundation for what may be called physiological anatomy. He studied the stomach from every aspect and with a wide range of methods. Here is the beginning of his brilliant work on the fibers of the connective tissues; here the studies on the normal contraction-wave of smooth muscle and the experiments on the reversal of those waves. In his paper on the stomach is this brief note:

> Recently I have found that irritation of the splanchnic nerve causes contraction of the mesenteric vein.

He probably first made this observation in Ludwig's laboratory and subsequently proved that the portal vein is supplied with vasomotor nerves, a valuable discovery in physiology.

The most important idea of this early work from the standpoint of anatomy is that of structural units, which Dr. Mall conceived from the study of the villus. The theory reaches its best expression in Dr. Mall's articles on the liver and spleen. It is that organs are made of ultimate histological units, represented in the vascular system by the capillary bed which intervenes between a terminal artery and its corresponding vein. Thus the size of the unit is determined by the length of the capillary. These units are grouped together into lobules. They are not only of great structural significance, since an organ is to be considered as a multiplication of them, but they are also of significance to physiology since such units are equal in

function. This equality of size and function comes from the laws of growth; when a unit increases in size so that the length of its capillaries increases beyond the norm, a new artery develops, the single unit splitting into two.

In his study on the spleen Dr. Mall brings out best the relation of all the tissues of an organ to its function. Thus he showed by experiments that the vessels of the spleen are emptied by the contraction of the bands of muscle on the trabeculae and that the fibers of these same trabeculae are so arranged as to distend the veins and compress the arteries as the muscles contract.

One of his valuable contributions is the study of the structure of the heart. He grasped the significance of the work of Krehl, which he said bore the stamp of Ludwig. In this work it is to be seen that the atrio-ventricular rings are tendons of origin for the bands of heart-muscle. In 1900 he gave the study of the bands of heart-muscle to John Bruce MacCallum, who unraveled the ventricles of the heart in the embryo pig into superficial and deep spiral bands with their origin and insertion in two tendons, the atrio-ventricular rings and the chordae tendineae. As a tribute to this brilliant work, Dr. Mall completed the study on the adult human heart after MacCallum's death, reducing the problem to the following simple terms: To understand the beat of the heart one must figure out how a muscular bag is constructed so as to empty itself. We have Dr. Mall's specimens in the laboratory showing how the spiral bands contract with each beat of the heart in the exact familiar pattern of wringing out a rag.

Another line of work which interested him greatly was the study of the brain. Here he was drawn to the anthropological side. Dr. Hrdlicka, the anthropologist in Washington, had said to him that the brain of a negro could be distinguished from that of a white man and with this in mind Dr. Mall made a comparative study of the brains in the anatomical collection, comparing them by weights, the complexity of their convolutions and other criteria. Realizing that no man can free himself of prejudice, he charted all of his data by means of numbers, filling in the race and sex only after the charts were complete. In this way he showed that the crude, present-day methods are inadequate for scientific deductions regarding the relation of the brain to race and sex. Of the criteria on race, there remains only the difference in the shape of the brain corresponding to the well-known shape of the head.

In his anatomical studies Dr. Mall has enriched his science with a wide range of methods. Our laboratory is full of examples of beautiful injections, corrosions of blood vessels, preparations of connective tissue made by maceration, cleared embryos to show the development of the skeleton and many others. His own methods of work in the laboratory are of great interest and he frequently discussed the influence of Ludwig in this connection. Contrary to the usual type, Dr. Mall was far more active mentally than physically. I have known him to think and plan with the greatest care so that a bit of routine might be simplified. Thus it was his habit to think out every detail of an experiment before he undertook it; he never employed the system of trying a thing out without adequate preparation or of approximating his methods through errors. For this reason he made but one experiment a day. If it failed, he would not repeat it until the next day, thus giving himself ample time to think out the reasons of his failure.

He was intolerant of the collection of unanalyzed material. His interest in technical procedures was only in their bearing

upon solving problems; it lay in understanding principles rather than in multiplying evidence.

We have outlined Dr. Mall's work in anatomy as it grew out of his study in Ludwig's laboratory. But he was not only an anatomist, he was also an embryologist. In 1891 he published an account of a normal human embryo, now placed in the fourth week of development. He made a most careful and accurate study of all of its systems, illustrated by the surface form, by models and casts. This was the first human embryo ever modeled in America and at that time it was the most complete account of any human embryo in existence. In this study he announced several discoveries, for example, that the Eustachian tube and the middle ear arise from the first branchial arch. The effect of this work on Dr. Mall is to be seen in these words in one of his publications:

> I always think in human anatomy in relation to this embryo.

Dr. Huber has said that this study has served as a model for all future work of its type. It did more for, like his work on the stomach, it represents as it were, Dr. Mall's program in embryology. This specimen forms the foundation of the priceless collection of over two thousand human embryos which Dr. Mall later gave the department of embryology of the Carnegie Institution of Washington. It was perfect, beautifully fixed and sectioned. When he had finished the description of it he offered it as a tribute to his teacher, His. His returned it, with several others of his own, expressing the wish that they might be the nucleus for a much larger collection. How richly has this gift borne fruit in the development of the science of embryology!

In the study of embryonic development, three names stand out in logical sequence, von Baer, His, Mall. Neither His nor Dr. Mall were concerned with the phenomena of maturation, fertilization or the cleavage stages, in the development of the embryo, but the latter has characterized the work of His as laying a foundation for histogenesis. In like manner the work of Dr. Mall in normal embryology may be summed up in the term organogenesis. He has traced the growth of organs up to their adult stage. He has laid the foundation for a complete anatomical survey of the human embryo in all stages of its development. Here, for example, belong his studies on diaphragm and the ventral abdominal walls and more strikingly his studies on the development of the loops of the intestine. These he followed from their beginning up to their position in the adult, he then determined their normal position in the adult by studies in the dissecting room, and by experiments on animals he showed that both the intestine and the omentum seek their normal position when disturbed. Of this work His wrote:

> Your satisfaction in your work will be lasting, because you have brought light into a field which was so obscure. The thing which has been lacking in all of our studies on development up to this time has been observations on the transition between the early embryonic and fetal stages up to the form of the adult. For the intestine you have given the entire study from the beginning up to the end, and I regard it a great step in advance.

It is in connection with the development of the vascular system that Dr. Mall made some of his most significant contributions to embryology. One of the most important points in the study of the embryo just mentioned was solving the problem of the primitive ventral branches of the aorta. This he did by showing that the vessels which are the forerunners of the celiac axis arise as far forward as the first dorsal segment and by indicating the method by which they shift back to their position in the adult. This work has since been repeated

with more specimens, but not analyzed with more insight. I recall in connection with these more elaborate subsequent studies on this subject, one of Dr. Mall's characteristic comments: "I can never become interested in the mere collection of new examples after a principle has once been thoroughly established." In connection with the study of the development of the vascular system the two lines of thought embodied in Dr. Mall's earlier work converge. These two generalizations I understand to be, first, that he approached anatomy from the standpoint of how structure is adapted to function, a different idea from that of the study of pure morphology, and secondly, that he saw the value of organogenesis to the study of anatomy. He carried over to embryology the methods of injecting blood-vessels and lymphatics in use for the adult and thereby made possible a complete account of the spread of vessels in the embryo. In the study of the vascular system he emphasized again and again the value of the study of an organ as a whole. Trained by the man who invented the microtome and himself making many improvements on it, he reacted strongly against those anatomists who study only sections. He was interested in the architecture of an organ; to use one of his own phrases he had "a feeling for structure." Indeed, he has often said that if he were to choose a career again, it would be that of an architect. His gift in anatomy, like the gift of the sculptor or the architect, was the power to visualize structure in three dimensions. Thus, one can understand his pleasure in the studies of the architecture of the vessels of organs, given not in indefinite terms, but showing the exact pattern of all vessels, the number and the relations of the orders of arteries from the main to the terminal branches. Thus he has left us a rich heritage of corrosions of the vessels of various organs which is worthy of a place in the great scientific museums of the world.

During the later years of his life, Dr. Mall became more and more interested in the problems associated with his collection; that is to say, in the type of problems for which institutes for research are founded, those that depend upon that analysis of large amounts of material and the cooperation of experts along closely allied lines. These problems touch more and more closely clinical medicine and social welfare. Such, for example, is the study of abnormal embryos, leading up to the analysis of their frequency and causes, the normal curve of growth, the determination of the age of the embryo and the causes of sterility and abortion. He first became interested in the study of abnormal embryos through separating the normal from the abnormal in his collection. His first general account of abnormal embryos was in the volume of the Johns Hopkins Hospital Reports published in honor of Dr. Welch in 1900. Eight years later he published a monograph on monsters, of which Morgan wrote:

> The recent publication by Mall on the causes underlying the origin of human monsters marks an epoch in the study of teratology in this country, for he has treated the subject with a breadth of view and a wealth of illustration rarely found in the handling of this complex question. Mall has brought to the task a profound knowledge of the older literature of the subject, an appreciation of the most modern results in experimental teratology, and a thorough familiarity at first hand with the subject of human monsters. The physician and anatomist are brought into close touch with work generally supposed to be outside their proper field; and on the other hand, the student of malformations in the lower animals will be made to appreciate the inexhaustible supply of human materials with which the anatomist and physician are familiar.

In this study and during the last six years, Dr. Mall has given a masterly analysis of the causes of monsters. He has shown

that from the earliest ages of the world's history the study of monsters has been one of the capital problems of anatomy, medicine and natural history; that the belief in supernatural causes gave way to the theory of maternal impressions, and that this must now give way to a scientific analysis of their causes. Dr. Mall recognized that a few abnormalities, polydactyly, for example, are germinal and can not be produced experimentally; but that monsters are not due to germinal or hereditary causes, but are produced from normal embryos by influences which are to be sought in their environment. The cause of monsters, he has indicated, lies buried in the non-committal term of faulty implantation. In his recent paper on cyclopia he has fully analyzed the meaning of recent experimental embryology. He showed that as soon as Stockard succeeded in experimenting with eggs in such a way as to produce cyclopian monsters at will, the explanation of the process was at hand, for the work demonstrated that a slight change in chemical environment, acting at a critical time, caused cyclopia. Dr. Mall studied the cyclopian monsters in his collection, one of which is at a stage where a complete analysis could be made, and in conclusion he says:

> It seems to me that the studies based upon our collection of embryos, as well as recent investigations in experimental embryology, set at rest for all time the question of the causation of monsters. It has been my aim to demonstrate that the embryos found in pathological human ova and those obtained experimentally in animals are not analogous or similar, but identical. A double monster or a cyclopian fish is identical with the same condition in human beings. In all cases monsters are produced by external causes acting upon the ovum.

Thus, most localized abnormalities and monsters, of which he gives a wealth of illustrations, can be traced back to the faulty nutrition of the embryo at early critical stages, and the effects can be followed with every grade of intensity, from complete degeneration of the ovum to monsters which survive to term. One of his most interesting deductions is that in some forms of faulty implantation there results a dissociation of the tissues of the embryo, so that they grow exactly as do the cells in the experiments with tissue cultures, without the correlating forces which check and integrate the organs in normal development. It is to my mind a significant example that this work has been carried on during the years given to the organization of a new institute, that is to say that Dr. Mall so planned the work of administration that it did not check research. It is not too much to say that this work of Dr. Mall's opens up a new field, and that it has already formed a broad foundation on which all future study of abnormalities must rest. Such was the work with which he was engaged at the time of his death. In his vision of an institute for embryological research, he saw that the two great lines of work in which he was most interested could be brought to a successful conclusion within a reasonable limit of time. First, that the full development of the study of organogenesis could give us a completely rationalized anatomy; second, that there is a group of problems such as the determination of the curve of growth, the study of abnormalities and their causes, normal and abnormal implantation which may perhaps be brought together under the heading of the study of the laws of growth, which lie beyond the powers of a single individual and thus must be attacked through organized research. Often he said during the latter months of his life: "My work is mapped out for the next ten years." Fortunately in his "Plea for an institute of human embryology" and in some unpublished manuscripts some of these plans are

recorded; but for the loss of those coming years that would have given us his greatest achievements, those achievements for which his whole life has been the preparation, no philosophy can console us. About a month before his death he put the question to me: "What would you say had been the effect of the Carnegie Institute of Embryology upon this laboratory?" to which I replied: "It has lifted the research of the place from a somewhat amateurish to a more professional state." Never shall I forget the pleasure in his face as he replied: "It is exactly what I wished to do." Such was his aim, such the ideal from which he had never swerved from the very beginning of his career.

No account of Dr. Mall's scientific work is complete without a mention of his contribution in the training of others. Of teaching he had the highest ideal. He once said: "What higher title could there be than that of a great teacher?" That he himself was one of the world's great teachers will be realized when his influence in the development of medical education in this country is adequately analyzed. To the general problems of education he gave deep thought and great originality. His own teaching was characterized by two broad principles, which were followed in his laboratory; first, that each student might approach his work in the spirit of a discoverer. Second, that since in each class there may be those who are destined to become the intellectual leaders of the next generation, liberty in education is essential in order that the strong personality might develop. In regard to the meaning of liberty in education, I shall venture to be specific in two points: He held that in the planning of courses in the laboratory, the directions for work should not be so minute and specific as to eliminate a student's initiative; and that his time should not be so completely filled with prescribed work that he could not follow his own bent in some line.

Dr. Mall's methods of training others were unique—so bound up with his own rare personality that none could copy, and few describe them. He had a gift, perhaps a genius for stimulating thought. Rarely indeed by question, the quiz he never used; it was more in the nature of an occasional suggestion, the acuteness of which impressed one more and more profoundly as one pondered over it. Perhaps his most fundamental quality was his rare generosity. I recall distinctly an instance in which a student had worked carefully and accurately with him without, however, understanding the meaning or the value of his observations. The student became discouraged and had decided to give up the work when Dr. Mall asked for his notes, and later published a very interesting paper under the student's name. This incident is the more interesting in connection with one of Dr. Mall's letters, written in the early days of the medical school when he was homesick for the laboratory of Leipzig. He told therein that before leaving Leipzig he had given some incomplete studies to Ludwig, evidently expecting him to use them in his own work, but that Ludwig had added experiments and published all under Dr. Mall's name. He then concluded, "Can you blame any one for wanting to return to one who would do things like that?" Ludwig, he wrote, was entirely without selfishness, and that when he tried to thank him for all he had done, he replied, "Pass it on." This indeed became the great watchword of Dr. Mall's life. Most freely did he give his ideas and his energies to his students. You will find no joint research with his students, for all that he gave them he meant to be theirs. He demanded in return the development of high standards of

work. In fact, perhaps the most lasting effect which he made upon the minds of his followers was the value of scientific standards and the meaning of ideals in research. He never gave first-hand praise; the only encouragement which a student received was a genuine interest in his work shown in such a way that the student came to find enjoyment where Dr. Mall found his—in the work itself. Many of his informal talks in the laboratory were on general topics or on principles rather than the specific development of research, and so general, so whimsical were these discussions that their meaning was lost entirely upon more than one student.

In directing departments there are certain leaders who train the students only in their own problems, giving little scope for independent work. Dr. Mall on the contrary was keen to give opportunities to those who could develop an independent line of research. Thus, for example, in his laboratory he developed the method of tissue-culture. Again, though his own work did not lead him into the newer fields of cytology, he saw to it that this work was represented. An even more striking example is that he was the first to see that the methods of anthropology might be applied with great value to the study of embryology; hence he brought into the department of embryology professional anthropologists thereby widening the scope of the science of embryology.

Closely bound up with his own scientific achievements is the part he played in the development of scientific publications in this country. According to his own account when he started out he hoped that the excellent *Journal of Morphology* would care for all the more complete publications of the laboratory, but it became hampered financially and finally suspended publication in 1903. During a term of years, those in the laboratory well remember that he constantly discussed the feasibility of establishing a new journal. At a meeting of the Anatomists held in Baltimore in 1900, a committee was formed to launch the *American Journal of Anatomy* and its first number appeared the following November. In 1906 followed the *Anatomical Record*, both published first in Baltimore. In 1908, when the *Journal of Morphology* was revived by the Wistar Institute of Anatomy, it was with Dr. Mall's work on monsters as its first number. More striking still as an example of Dr. Mall's ideas of developing scientific publications in this country, are the new Contributions to Embryology, published by the Carnegie Institution of Washington. His originality, far-seeing vision and courage for undertaking new enterprises could not be better illustrated than in connection with these journals.

In his introduction to the article on His, Dr. Mall wrote these words:

> The ancient science of anatomy has been perpetuated during many centuries by great men who have dedicated their lives to it. The list is a long one, for the development of science has been slow and progressive from the earliest ages up to the present time; we find in it, on the one hand, some of the names of the greatest who ever lived—Aristotle, Vesalius—on the other, the names of those who rank as leaders of a generation, Bichat, His.

With Bichat and His belongs the name of Mall. His name will be associated with the strongly physiological bent of modern anatomy, with the laying of a broad foundation of organogenesis in embryology, and with the vision of a broadening of the scope of embryology so as to bring it into relation with the problems of clinical medicine and social welfare. In America, his place is unique; it goes without saying that he was our greatest anatomist. More than any other man in American medicine, he had led his generation into the way of research.

FLORENCE R. SABIN

SCIENTIFIC EVENTS

THE BRITISH COMMITTEE FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

Some points in the report of the British Privy Council committee for scientific and industrial research are summarized in the *Electrical World* as follows:

Funds Available.—The Imperial Trust for the Encouragement of Scientific and Industrial Research holds £1,000,000 that Parliament has voted for research purposes. Manufacturers' associations, the London County Council and some governmental departments have also contributed funds for specific purposes.

Personal Grants to Research Workers.—Thirty-six awards in the nature of maintenance grants were made to individuals, of which twenty-four went to students being trained in the methods of research, ten to independent research workers and two to research assistants. Grants will also be made for apparatus and materials.

Industrial Versus Pure Science Research.—During the past year the committee has devoted its chief effort to the organization of industrial research rather than to the prosecution of work in pure science; first, because it felt the paramount importance of arousing the interest of manufacturers and, second, because of the influence of the war. It emphasizes the hope that the absence of references to pure science should not be taken as indicating a lack of appreciation of its importance.

Trade Research Associations.—Many trade associations have lately come into existence, some of which include research among their objects. The committee has helped in their organization and has assisted and cooperated in their research activities.

Research in the Universities.—Hearty cooperation of the principal universities, technical schools and trade schools in England has been secured, and their resources have been coordinated for the important problems on hand. A closer connection is being established between these institutions and the industries which rely upon results of research in the manufacture of their products.

Technical Societies.—The committee is cooperating with the electrical, mechanical and mining engineers' institutions and other professional societies, in some cases subsidizing the researches originated by the institutions and extending their scope.

Information Collected and Published.—In cooperation with technical societies and institutions of learning the committee has collected and published available information and is continuing this useful work, which will greatly simplify that of future investigators. It is also preparing memoranda on various fields for research, with an analysis of the problems involved and the proposed program for research.

Assistance to Individual Manufacturers.—An arrangement has been made with the Royal Society by which it will assist the committee in selecting the institution or research workers best fitted for a particular investigation. If the investigation progresses satisfactorily, the manufacturer is invited to contribute part or all of the expense in exchange for the exclusive use of the results over a given period. Another proposed way is to attach an investigator to the works laboratory and share expense with the manufacturer.

GOVERNMENT CONTROL OF THE PLATINUM INDUSTRY

The Council of National Defense has issued the following statement:

Through Ordinance Requisition No. 510 from the Secretary of War, the government has taken over control of the production, refining, distribution and use of crude and refined platinum for the period of the war. The control will be exercised through the chemical division of the War Industries Board. The chemical division sent out to the industry requests for inventories of the existing stock of crude and refined platinum and platinum-iridium alloys as of March 1, 1918.

The letter stated that it was not the intention of the government to take over and handle directly the present stock of platinum but to permit its shipment by the producers or dealers subject to certain conditions. Upon the fixing by the Secretary of War of a reasonable price for crude, refined and alloyed platinum,

notice will be given and blanks issued governing delivery and distribution.

The letter sent out by the chemical division includes the following directions to producers:

1. That producers, refiners and dealers in platinum continue to dispose of their product for government purposes, and for that only, as directed by the chemical division.

2. That producers, refiners and dealers in platinum who are also consumers use platinum for government purposes, and for that only, as directed by the chemical division.

3. That all obligations arising out of transactions in the production or delivery of crude, alloyed or refined platinum released as above, including all claims for shortage, poor quality, damage or loss in transit, be borne by the producer or seller, as the case may be, in accordance with existing trade practises.

Distribution may be made by consent of this board through agencies under existing arrangements, provided that there results no increase over the existing price to the user.

The undersigned, on separate application in each case, will consider permitting the delivery of a limited amount of platinum for essential commercial purposes not for government account.

Proper blanks upon which application for re lease of shipment should be made will be furnished on application.

The following list indicates, in general, the order of preference which will be followed in releasing platinum for shipment: First, military needs of the United States government; second, military needs of allied governments; third, essential commercial purposes.

PHOTOGRAPHERS FOR THE SIGNAL CORPS

ONE thousand men trained in photographic work are needed by the Signal Corps immediately for instruction at the new school for aerial photography just opened at Rochester, N. Y., preparatory to going overseas.

This ground force for America's aerial photography requires three types of men:

1. Laboratory and dark room experts, especially fast news photographers, familiar with developing, printing, enlarging, retouching, finishing and panchromatic photography, who can take a plate from the airmen and hand it over ten minutes later a finished enlargement to the staff officers. These men will work in motor lorries as close to the front and to the staff as possible.

2. Men able to keep the whole delicate equipment in good condition, such as camera and optical construction and repairmen, lens experts, cabinetmakers, instrument makers, etc.

3. Men to fit the finished prints into their proper places in the photographic reproduction of the German front, to work out the information disclosed, and to keep the whole map a living hour-to-hour story of what the Germans are doing. This includes men familiar with map compilation, map-reading and interpretation, topographical science and drafting, and requires keen analytical powers.

The primary training at Rochester will cover four weeks, and will be standardized along the highly specialized developments brought out in the war. At its close the successful graduates will be sent on for a month of advanced training, after which they will be organized into units and sent overseas.

The best men, however, will be given still further training for commission as photographic intelligence officers first at one of the schools and then in actual flights at the flying fields.

Many men not physically fit for line service are eligible for this so-called limited military service, as defective vision corrected by glasses and other minor physical disabilities are waived. The proportion of officers and non-commissioned officers to privates will be higher here than usual, so that the opportunity for advancement is good.

Men not registered for the draft and who possess the necessary qualifications should write to the Air Division, Personnel Department, 136 K Street, NE., Washington, D. C., for information as to enlistment, accompanying their letter with evidence of their qualifications.

Men registered for the draft in the states of New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Missouri Massachusetts, New Jersey, Rhode Island and Maryland, who desire to be voluntarily indicted for this service, should apply to their local board and submit evidence of their qualifications. At present

these are the only states to which this call applies.

Owing to the shortness of time it is requested that only men fully qualified apply for this service.

SCIENTIFIC NOTES AND NEWS

Professor William F. Durand, of Stanford University has been made chairman of the National Advisory Committee for Aeronautics.

Four of the college deans or former deans of Ohio University are now majors in the National Army: Dr. Edward Orton, Jr., of the College of Engineering; Dr. William McPherson, of the Graduate School; Dr. Eugene F. McCampbell, of the College of Medicine, and Dr. David S. White, of the College of Veterinary Medicine. Dr. Henry R. Spencer, appointed dean of the Graduate School in Dr. McPherson's absence, is now in Y. M. C. A. service abroad.

Dr. William Libbey, professor of physical geography at Princeton University, has been commissioned major in the Ordnance Department, and is now awaiting orders. He has long held a commission in the New Jersey National Guard.

Dr. George S. Meylan, associate professor of physical education at Columbia University, has been granted a further leave of absence to continue his work with the Y. M. C. A. in France.

Dr. W. B. Bentley, head of the Department of Chemistry of Ohio University, has been commissioned as captain by the War Department, and is stationed at Watertown, Massachusetts, in the Department of inorganic chemistry, of the Watertown Arsenal.

Dr. Bird T. Baldwin, who last year left Swarthmore College to accept the directorship of a newly established child-welfare station of the Iowa State University has enlisted in the sanitary corps of the army. He has the rank of major and will be engaged in the work of testing recruits by psychological methods.

Dr. Henry H. Goddard for ten years head of the research department of the Vineland training school, has been appointed head of the Bureau of Juvenile Research of the State of Ohio. Dr. Goddard will go to Ohio in May, returning to the Training School for the Summer School for Teachers to take charge of the laboratory work.

Watson Bain, professor of applied chemistry at the University of Toronto, has been granted leave of absence for the duration of the war. He is going to Washington, D. C., where he will be on the staff of the Canadian mission.

Colonel Herbert S. Birkett, C.M.G., dean of the medical faculty of McGill University, Montreal, and who has been overseas in command of their base hospital, has returned home on account of ill health. Colonel John M. Elder has taken over the command of the hospital.

Dr. John E. Bucher, professor of chemistry in Brown University, has been granted leave of absence for the second semester of the academic year, in order to devote himself to experimentation in chemical processes in the industry. He will continue to direct the work of certain advanced students in the university laboratory, but will be relieved of all teaching during the remainder of the year. Dr. Robert F. Chambers, a Brown graduate, will be acting head of the department during the second semester.

Dean R. H. Forbes, of the University of Arizona College of Agriculture, and for eighteen years director of the Arizona Agricultural Experiment Station, has been granted a year's leave of absence for agricultural service in Egypt and is at present en route for Cairo. Dean Forbes is a specialist in semi-arid subtropical agriculture of the kind common to both Arizona and Egypt.

Dr. A. I. Ringer has been appointed special consultant in diseases of metabolism at the German Hospital, New York City.

Stephen S. Visher, Ph.D. (Chicago), has been appointed a land classifier in the United States Geological Survey.

Professor H. H. Love and Instructor William T. Craig, of the department of plant breeding, Cornell University, are cooperating

with the Federal Department of Agriculture in breeding improved cereals.

DR. MOURIER, who represents the Gard in the French Chamber of Deputies, has succeeded M. Godard as under secretary for health in the Ministry of War.

THE British Minister of Pensions has appointed Sir John Collie to be director of medical services for the Ministry of Pensions.

SIR NAPIER SHAW, director of the British Meteorological Office, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston.

THE British polar medal has been given to Lieutenant Sir Ernest Shackleton, Lieutenant Frank Wild and forty-two other members of the Imperial Transantarctic Expedition of 1914-16.

AT the anniversary meeting of the Royal Astronomical Society held on February 8 the officers and council elected, as recorded in *Nature*, are as follows: *President*, Major P. A. MacMahon; *Vice-presidents*, Professor A. S. Eddington, Dr. J. W. L. Glaisher, Professor R. A. Sampson and Professor H. H. Turner; *Treasurer*, Mr. E. B. Knobel; *Secretaries*, Dr. A. C. D. Crommelin and Professor A. Fowler; *Foreign Secretary*, Dr. A. Schuster; *Council*, Mr. A. E. Conrady, the Rev. A. L. Cortie, S.J., Dr. J. L. E. Dreyer, Sir F. W. Dyson, Colonel E. H. Hills, Mr. J. H. Jeans, Mr. H. S. Jones, Mr. E. W. Maunder, Dr. W. H. Maw, Professor H. F. Newall, Professor J. W. Nicholson and the Rev. T. E. R. Phillips.

SIR J. C. BOSE delivered an address at the recent opening ceremony of the Bose Research Institute at Calcutta, of which he is the founder.

PROFESSOR WILLIAM M. DAVIS, Sturgis-Hooper professor emeritus of geology, has prepared a "Handbook of Northern France," which has the approval of the geography committee of the National Research Council, and a considerable number of copies will be distributed free at cantonments, which thirty contributors to a fund of nearly $8,000 may designate. The Harvard University Press will print the book, which will also be placed on sale.

ELMER V. MCCOLLUM, Ph.D., professor of chemistry in the school of hygiene and public health, the Johns Hopkins University, will give the Cutter Lectures on Preventive Medicine and Hygiene, at the Harvard Medical School on March 19, 20 and 21. The subjects are: "The essentials of an adequate diet," "The special dietary properties of our natural foodstuffs" and "The dietary habits of man and their relation to disease."

THE course of lectures on "Wild Life" at Cornell University for the month include "The economic value of birds" and "The cat and rat problem," by E. H. Forbush, state ornithologist of Massachusetts; four lectures on pheasants, breeding, care and rationing of the young, combating of vermin and disease, and miscellaneous problems, by E. A. Quarles, of the American Game Protective Association, and H. T. Rogers, superintendent of the State Game Farm; "The breeding of wild turkeys" and "The breeding of diving ducks," by H. K. Job, of the National Association of Audubon Societies.

A COURSE of public lectures on "Animal life and human progress" is being given at King's College, London. The program includes Professor A. Dendy on "Man's account with the lower animals"; Professor G. C. Bourne on "Some educational and moral aspects of zoology"; C. Tate Regan on "Museums and research"; Professor J. Arthur Thomson on "Man and the web of life"; Professor F. Wood Jones on "The origin of man"; Dr. R. T. Leiper on "Some inhabitants of man and their migrations"; Professor R. T. Punnett on "The future of the science of breeding"; Professor W. A. Herdman on "Our food from the sea"; and Professor Robert Newstead on "Tsetse-flies and colonization." It is intended to publish the lectures in book form.

THE Brooklyn Teachers' Association has appropriated $1,000 toward the fund to erect a memorial to the late Franklin W. Hooper, the founder of the Brooklyn Museum.

Dr. Alfred Lacroix, secrétaire perpétuel of the Académie des Sciences, Paris, and professor and curator of the department of mineralogy of the Muséum d'Histoire Naturelle, of Paris, has in preparation a life of the great mineralogist *Dolomieu* (1750–1801), and is interested in any information leading to the location of manuscripts, letters or signatures of that great scientist. Any letters or signatures of Abbé René Just Haüy are especially desired, and these, or any information relating to them, can be addressed to George F. Kunz, Abbé Haüy Celebration Committee, 405 Fifth Avenue, New York City.

Steps have been taken to raise a memorial to the late Dr. Elizabeth Garrett Anderson from the women of England. It will be devoted to the endowment of beds in the New Hospital for Women, Euston Road, which she founded in 1866. A sum of over £9,000 has already been received, and a number of women's colleges and schools have undertaken to raise £7,000.

Dr. Charles Parker Lyman, who was fifteen years dean of the Harvard School of Veterinary Medicine, died in Los Angeles, on February 1, aged seventy years.

Lieutenant Colonel John McCrea, of the Canadian Army Medical Corps and the department of pathology of McGill University, has died in France.

The late Dr. Ludwig Mond undertook to pay £62,000 as an endowment fund for the David Faraday Research Laboratory of the Royal Institution before 1926. His trustees have now anticipated the obligation, and have transferred £66,500 in 5 per cent. war stock to the trustees of the Laboratory.

Undergraduates between the ages of eighteen and twenty-one in technical colleges may enroll as second class seaman in the Naval Reserve force for future service, according to the announcement of the Bureau of Navigation of the Navy Department. The students will not be called upon for active duty until they have been graduated, except in case of great emergency, which is not now anticipated by naval authorities. No promise is held out that the recruits will later be commissioned, but upon graduation they will take examinations, and the ratings they make will determine whether their qualifications merit promotion. Navy recruiting officers have been instructed to communicate with technical colleges and universities with a view to enrolling students who are eligible.

The United States Public Health Service of the Treasury Department has practically completed plans for preventing malaria among soldiers at camps and cantonments during the coming spring and summer. In a zone from one to two miles wide around twenty or more camps in the south every known effective method of eradicating the disease will be employed under the supervision of experts. In the camps themselves the Army authorities will control the disease. At each camp where there is danger of malaria an expert, probably a sanitary engineer, will be in charge of the malaria operations.

Sir A. Mond said, in the House of Commons on February 18, as quoted in *Nature,* that the Imperial Institute was partly occupied for the sugar rationing purposes of the Ministry. As to the new Science Museum, it was in course of construction, and incomplete. It had been represented that the work of construction ought to be continued during the war, but he was not in a position to complete the construction of museums in existing circumstances. Considerable expense had been incurred in making the finished part of the building suitable for the work now to be done there. Museums now wholly or partly occupied by government departments were the National Gallery, the Tate Gallery, the Wallace Gallery, the Victoria and Albert Museum and the British Museum, of which a small part had been taken over.

UNIVERSITY AND EDUCATIONAL NEWS

Richmond College has received a gift of $60,000 from Mr. and Mrs. Clarence Millhizer, of Richmond, Va. This sum is to be used in the erection of a gymnasium which will be a

memorial to their son, whose death occurred on February 24.

BY the will of Mrs. Charlotte M. Fiske, of Boston, public bequests to the amount of $130,000 are made. Tuskegee Normal School, Roanoke College and Bates College receive $5,000 each and Wellesley College receives $10,000 and the residue of the estate.

SENATOR W. C. DENNIS, president of the *Halifax Daily Herald*, has presented $60,000 to Dalhousie University in memory of his son, Captain Eric Dennis, killed at Vimy Ridge. The gift provides that the university shall found a chair of government and political science.

DR. EDWIN BISSELL HOLT, assistant professor of psychology at Harvard University has resigned, his resignation to take place on September 1, 1918.

AT the University of Chicago Dr. Harvey B. Lemon, instructor in the department of physics, has been promoted to an assistant professorship; and Dr. A. L. Tatum, professor of pharmacology in the University of South Dakota, has been made an assistant professor in pharmacology and physiology.

T. J. MURRY, formerly associate bacteriologist of the Virginia Agricultural Experiment Station and associate professor of bacteriology at the Virginia Polytechnic Institute, has been appointed associate professor of bacteriology at the State College of Washington and bacteriologist of the Washington State Experiment Station.

DISCUSSION AND CORRESPONDENCE

THE NOMENCLATURE OF THERMOMETRIC SCALES

TO THE EDITOR OF SCIENCE: Present usage in nomenclature of thermometric scales is a cause of indefiniteness and confusion of ideas, and some revision seems called for. Accordingly, I hope the statement of the case which follows[1] will elicit helpful suggestions and tend toward useful results.

The consensus of scientific opinion and practise is all but universally in favor of the familiar Centigrade scale of temperatures by which the temperature of melting ice and of condensing steam, both from water and under a pressure of one standard atmosphere, are designated 0° and 100° respectively. By general consent the value of other temperatures than the two points thus fixed by definition are defined by the normal constant volume hydrogen thermometer of the International Bureau of Weights and Measures as realized by certain mercury in glass thermometers. In recent years the scale of temperatures defined by the varying resistance of pure platinum is also accorded the status of a thermometric standard when its thermal coefficient as defined by the Callendar equation is evaluated by observations at the melting and boiling points of pure water, and at the boiling point of sulphur under standard conditions defined to be 444.5° or 444.6° C.

All other thermometric scales that depend on the physical properties of substances may, by definition, be made to coincide at the ice point and the boiling point with the normal scale as above defined, but they will diverge more or less from it and from each other at all other points.

To obviate the difficulty which arises because thermometers of different types and substances inherently disagree except at the fixed points, Lord Kelvin proposed many years ago that temperatures be defined by reference to certain thermodynamic laws. This course furnishes a scale independent of the nature or properties of any particular substance. The resulting scale has been variously named the absolute, the thermodynamic, and more recently in honor of its author, the Kelvin scale. The temperature of melting ice by this scale on the centigrade basis is not as yet accurately known, but it is very nearly 273.13°, and that of the boiling point 373.13°.

Occasions arise with increasing frequency in which meteorologists, physicists, and others in dealing with problems of temperature are required to use an absolute scale or an approximation thereto, and to publish temperature data in those units. It is not convenient, and in many cases not necessary, to adhere

[1] See also Monthly Weather Review, Nov., 1917.

strictly to the true thermodynamic scale. In fact, the general requirements of science are very often largely met by the use of an *approximate* absolute scale which, for the centigrade system, is defined by the equation

$$T = 273. + t^{\circ} \text{ Cent.}$$

The observed quantity, t°, may be referred to the normal hydrogen centigrade scale or be determined by any acceptable thermometric method. This approximate scale is often called the "absolute" or the Kelvin scale, perhaps for the sake of brevity or convenience. Of course, no one can disregard the technical differences between the real and false or approximate, absolute scale.

Such a scale differs from the true Kelvin scale, first, because 273° is not the exact value of the ice point on the Kelvin scale; second, because each observed value of t° other than 0° or 100° requires a particular correction to convert it to the corresponding value on the Kelvin scale. These corrections will differ according to the kind of thermometer used in obtaining the value t° and while they are small for temperatures between 0° and 100° they are large at extreme temperatures and are important in all questions involving thermometric precision.

The *approximate* absolute scale is sufficiently exact for nearly all purposes, it is most convenient in computations and in the publication of results; further, its numerical quantities are strictly homogeneous, and should any necessity arise data published in its units may be readily reduced to the absolute Kelvin scale by simply applying the appropriate correction for the zero point of the scale—about 0.13° C.—and the other appropriate correction to reduce the observed temperature, t°, to the true thermodynamic temperature. It is thus clear that much confusion and uncertainty of terminology and meaning would be obviated and Kelvin's suggestion properly appreciated if scientists would agree to *give the approximate absolute scale a particular name of its own* and reserve the name "absolute" for the scale that is truly absolute, viz., Kelvin's absolute thermodynamic scale.

In accordance with the foregoing ideas, the thermometric scale and nomenclature in the centigrade system may be set forth in the following manner:

THERMOMETRIC NOMENCLATURE

AS IT IS

	Fiducial Points	
	Freezing	Boiling
Centigrade scale		
Normal hydrogen constant-pressure thermometer	0°	100°
Thermodynamic scale	All frequently loosely designated Absolute Scale in scientific literature.	
Absolute scale		
Kelvin scale		
Approximate or "near-absolute" scale defined by the equation—$T = 273 + t^{\circ}$ Cent.		

AS IT SHOULD BE

Centigrade scale	0°	100°
Thermodynamic scale	273.13°	373.13°
Absolute scale	Strictly synonymous and strictly one ideal scale.	
Kelvin scale		
"Approximate-absolute (?)"	273°	373°

Let us prevent confusion and uncertainty, make the meaning of scientific writings clear and distinct, by giving an appropriate name to the scale

$$T = 273 + t^{\circ} \text{ Cent.}$$

Such a name will have the significance of—

Quasi-absolute, symbol Q or A_q.
Approximate absolute, symbol A_a, or *aa*.
Pseudo-absolute, symbol P.

It should be a short word if possible and suggest a good symbol for its abbreviation. The above list of names is tentative and suggestions from others are requested.

C. F. Marvin

Weather Bureau,
Office of the Chief,
Washington, D. C.

THE DOMESTICATION OF THE LLAMA

To the Editor of Science: For many years one of the favorite arguments of those who wish to prove an immense antiquity for the peoples of the Andean area has been that thousands of years must have gone by before the llama and its kindred, the alpaca, the vicuna, the huanacu, could have been brought

to their present condition of domestication. In the opinion of the present writer, who is now in Peru and who has lately been in Bolivia as well, this argument is of slight, if any, value. From close study of the matter it becomes clear that the llama is only partially domesticated. There are several criteria of domestication: If an animal depends upon a man for its food, if it breeds while in captivity, if it needs to be artificially sheltered from the stress of weather, if it is obedient to the wishes of its owner, it may be said to be domesticated. It is quite certain that by far the greater part of the llama species to-day feed themselves, refuse to breed in captivity (or, at any rate, generally breed when as far as possible from man), and do without shelter. It is true that the llama is more or less obedient to its owner, but it is a docile animal by nature, and, so long as it is not overloaded, it is a ready worker in its own way. Since this is so, it is quite clear that the llama is only partially domesticated, or rather, that it has been partially subjected to the uses of man, and it is certain that its status does not imply any long period of human influence.

PHILIP AINSWORTH MEANS

LIMA, PERU,
November 29, 1917

THE ORIGIN OF THE CUSTOM OF TEA DRINKING IN CHINA

TO THE EDITOR OF SCIENCE: I have been much interested in a statement which occurs in the late Professor King's book "Farmers of Forty Centuries" relative to the origin of the custom of tea drinking in the Orient. Professor King states (p. 77):

> In a sampan managed by a woman and her daughter, who took us ashore, the middle section of the boat was furnished in the manner of a tiny sitting-room, and on the sideboard sat the complete embodiment of our fireless cookers, keeping boiled water hot for making tea. This device and the custom are here centuries old and throughout these countries boiled water, as tea, is the universal drink, adopted no doubt as a preventive measure against typhoid fever and allied diseases.

And (p. 323):

> The cultivation of tea in China and Japan is another of the great industries of these nations, taking rank with that of sericulture, if not above it, in the important part it plays in the welfare of the people. There is little reason to doubt that the industry has its foundation in the need of something to render boiled water palatable for drinking purposes. The drinking of boiled water has been universally adopted in these countries as an individually available, thoroughly efficient and safe guard against that class of deadly disease germs which it has been almost impossible to exclude from the drinking water of any densely peopled country.

These statements would indicate the following sequence of events: (1) the pollution of the drinking water, (2) disease arising from this pollution, (3) boiling of the drinking water to prevent disease, (4) addition of tea leaves to mask the insipid taste of the boiled water. While I have no doubt but that the first two items occurred in the order given, I have very grave doubts as to the sequence of the third and fourth items. It is extremely improbable that it was recognized centuries ago that typhoid fever, etc., were disseminated by pollution of the water supply, especially inasmuch as there was no knowledge of microorganisms or of the rôle which they play in disease until the work of Pasteur (1857–1863). Undoubtedly disease with the Chinese, as with every other people, was early regarded as the act of demons or a visitation of the gods.

To my mind, cause and effect were somewhat as follows: (1) The drinking water was undoubtedly polluted and typhoid, cholera, dysentery, etc., were endemic. (2) Certain families or clans found that a pleasing beverage could be made by steeping the leaves of the tea plant in hot water with the result that they drank very little if any of the polluted waters without previously boiling it. (3) Their neighbors or neighboring communities observed that these families or clans who drank tea had relatively little disease as compared with the non-tea drinkers and as a result the custom of tea drinking spread

throughout the land not because of the belief that boiled water prevented disease and tea leaves modified the insipid taste of the boiled water, but because the infusion of the tea leaves *per se* was looked upon as a medicine specific for the prevention of the prevalent diseases.

Ross Aiken Gortner
University of Minnesota

SCIENTIFIC BOOKS

Applied Psychology. By H. L. Hollingworth and A. T. Poffenberger. D. Appleton and Co., New York, 1917. Pp. xiii + 337.

This book will properly attract many readers who wish to know the significance of the practical movement in psychology. As the first text-book in applied psychology it gives a well-balanced presentation of the aims, methods and scope of this new "type of interest and pursuit." Nowhere else have the results and methods of approach for practical problems been so completely assembled and so well guarded from misuse. Although it does not reach the dignity of a treatise on applied psychology, this admirable book by two members of the department of psychology at Columbia University will be appreciated both by general readers and by those psychologists who wish to vitalize their introductory courses by associating them with student interests. Only a few colleges as yet have offered a course which attempts to cover the broad field of applied psychology, but within a year a professorship in applied psychology has been established, the *Journal of Applied Psychology* started, and a Division of Applied Psychology under that title organized in an institute of technology. Whether a unit of instruction entitled applied psychology touches too varied interests and affords too meager content will doubtless continue for some time to be a question for each college to decide. It is certainly too early to expect a text to take the place of a teacher.

Besides bringing the results of many scattered researches together, the authors have helped to organize this branch of psychology by carefully distinguishing and illustrating three main forms of application to practical problems. These three forms include psychological analysis of a situation, carrying over of principles worked out in allied researches, and the adaptation and improvement of technique. With this scientific procedure in the foreground, they have avoided the unpleasant effect on the student of either a very limited technical monograph or of the magazine literature of the prophetic promoter. The first portion of the book summarizes in compact and usable form the psychological work which helps to understand general human efficiency and how to increase it. It includes the influences of heredity, sex and maturity, environmental factors like illumination and ventilation, the principles derived from the studies of the learning process, the effects of work and rest, stimulants, etc. The second half of the book sets forth the psychological procedure in those fields of occupational activity in which the applications have been most explicit. These include employment management, the industrial workshop, advertising and salesmanship, law, social work, medicine and education.

The task of guarding the foundations of the new division of their science has not been assumed lightly by the authors. Instead of the usual illustrations from individual cases, which may or may not be exceptions, we find the constant citation of experiments bearing upon a problem with a careful discussion of the sources of error and the dangers of generalization from the particular investigation. Instead of mere psychologizing about work methods we now have much emphasis on the technique under which the conclusions were reached. The teacher of the consulting psychologist must evidently train him in technical methods of research and the interpretation of results. The authors look forward to that day when the engineering type of psychotechnical expert will meet with other specialists to cooperatively attack their joint problems, instead of the make-shift procedure under which the specialist in business, medicine, education, etc., attempts to dabble in psychology or the psychologist to dabble in other specialties.

To those who studied their psychology with the introspectionist school it must be strange to find brought together under a psychological heading, the work of the physiologist on drugs and fatigue, of the engineer on motion-study, of the biologist on heredity, of the psychiatrist on mental abnormality, of the clinician on mental development, and of the educator on learning, in addition to the research of the psychologists. It marks the change in psychology to the more objective study of behavior. Applied psychology rejoices that it affords a clearing house for any knowledge which bears directly upon the understanding and control of human action.

The authors cite telling examples in which scientific studies of the human factor have produced better results than the hit-or-miss methods of practical sense in dealing with business, industrial, and professional problems. In many other cases than industrial accidents it will doubtless be found that the most important cause to be controlled is not in the field of the applied physicist but in the field of human engineering. In leaving the book, if the reader still feels that we are yet only on the threshold of a new pursuit, he will at least have found abundant evidence scientifically formulated to convince him that we are on the threshold and not merely viewing the house at a distance.

J. B. Miner
Carnegie Institute of Technology

SPECIAL ARTICLES

NOTE ON THREE DEVICES FOR USE IN ELECTROMETRY

During recent work with an electrometer the author has employed three devices which are obvious enough and can hardly be novel, but which seem worth putting more definitely on record as tested devices.

(1) A simple means of increasing the deflections of an electrometer is often wanted under circumstances where the use of a sufficiently long distance from mirror to scale is inconvenient. This may be accomplished by interposing a concave lens between mirror and scale, thus magnifying the deflection. A lens of rather long focus placed, if anytihng nearer the mirror (fig. 1) is preferable, as the effects of chromatic aberration are thereby diminished and the proportionality of the deflections is also better preserved. The image will be much brighter if a *cylindrical* lens is used; such a lens can be secured quickly and at small expense as a special order from Bausch & Lomb.

By this means a Dolezalek electrometer with platinum fiber was raised from 3,000 to 18,000 mm. per volt at a scale distance of 4 m. Owing to diffraction, the spot was about 1 mm. wide, but its position could be read to 0.2 mm., and the proportionality between deflection and potential was very good.

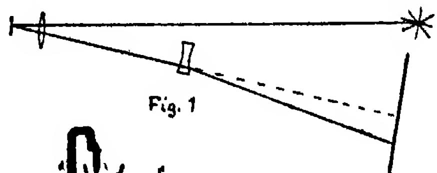


Fig. 1

Fig. 2

(2) Sometimes one wants a simple means of connecting two wires together which will permit of easier disconnection than a soldered joint and yet will not introduce the additional capacity and possible leakage of a key. For this purpose one may solder a little silver cup to one wire and then attach the other wire to a piece of heavy wire tipped with a silver point and bent so that the point rests upon the floor of the cup (fig. 2). Silver oxide being a fairly good conductor, the slight pressure thus obtained is quite sufficient to make good contact.

(3) To obtain time signals at rather long intervals a torsion pendulum is more useful than a gravity pendulum because of the ease with which the period may be varied over a wide range. If the inertia system consists of a light cross-rod carrying two heavy sliding weights, then the period is approximately proportional to the distance of the weights from the center, so that a range of 1 to 10 in the period is easily obtained. The system can be

rendered stable by a rigid upright in the center; and a wire on one end of the cross-rod is easily arranged to close a mercury contact and actuate a sounder.

E. H. Kennard

University of Minnesota

THE AMERICAN SOCIETY OF PHARMACOLOGY AND EXPERIMENTAL MEDICINE

The ninth annual meeting of the American Society of Pharmacology and Experimental Therapeutics was held in Minneapolis on Thursday and Friday, December 27 and 28, 1917, and in Rochester, Minnesota, on Saturday, December 29. The following program was presented:

Two papers by David I. Macht were read by title:

"On the comparative absorption power for drugs of the bladder and urethra (male)."

"On the relation of the chemical structure of opium alkaloids to their action on smooth muscle structures."

FIRST SESSION

Thursday Afternoon, 2:00 to 4:30

Experimental observations on anaphylaxis in the dog: Mort D. P., and D. E. Jackson.

Effect of adrenalin on vaso-motor and on heart action studied separately by means of elimination of blood pressure through compensation: C. McPeek, R. J. Seymour and Clyde Brooks, University of Ohio.

The action of drugs on different parts of the intestine: W. C. Alvarez, Hooper Institute, San Francisco.

The location of the adrenalin vasodilator mechanisms: Frank A. Hartmann, University of Toronto.

The growth of chickens under laboratory conditions: Lafayette B. Mendel and Thomas B. Osborne, Yale University and Connecticut Experiment Station.

The Distribution and Function of Certain Nerves: D. E. Jackson and Mort P. Pelz, Washington University.

Studies with American grown digitalis and with digitalis lutea: S. M. White and R. E. Morris, University of Minnesota.

The effect of alcohol on the vaso-motor and respiratory mechanisms: E. G. Hyatt and Viggo Jensen, Illinois University Medical College.

The influence of Yohimbine on reproductivity: Florence L. Rumey, Illinois University Medical College.

The action of lactic acid on the respiratory center: Seymour J. Cohen, Illinois University Medical College.

The stimulation of the vago-gastric medullary center by drugs: Fred. T. Rogers, University of Chicago.

SECOND SESSION

Friday Morning, 9:00 to 12:00 M.

Effects of iodine on the eggs of sea urchins: E. P. Lyon, University of Minnesota.

Antagonistic action of drugs on the respiratory center: C. Voegtlin and C. J. Wiggers, Hygienic Laboratory, Washington, D. C.

Stimulation of the respiration by sodium cyanide: A. S. Loevenhart and Messrs. Lorenz, Martin and Malone, University of Wisconsin.

The reaction of the respiratory mechanism to chlorine gas: W. H. Schultz, University of West Virginia.

The influence of chlorine upon the heart: W. H. Schultz, University of West Virginia.

A study of acute bichloride intoxication in the dog: Wm. DeB. MacNider, University of North Carolina.

Cross tolerance: renal response to caffein and theobromin in rabbits long tolerant to caffein: Harold B. Myers, University of Oregon.

Straub's biologic test for opium alkaloids: Florence L. Rumey and Viggo Jensen, Illinois University Medical College.

The influence of pituitary extracts on the daily output of urine: H. M. Rees, University of Chicago.

Effects of external temperature and certain drugs on thyroid activity: A. C. Mills, University of Kansas.

Does atropin alter the effects of digitalis upon the tonus of heart muscle: A. D. Hirschfelder, University of Minnesota.

Effects of amino acids and their salts upon the contraction of intestinal strips: A. D. Hirschfelder and W. Cantwell, University of Minnesota.

Acridity of some plants due to a mechanical action: E. D. Brown and D. D. Anderson, University of Minnesota.

The mode of action or anesthetics in producing anesthesia: W. E. Burge, University of Illinois.

SCIENCE

FRIDAY, MARCH 22, 1918.

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THEODORE CALDWELL JANEWAY

THEODORE CALDWELL JANEWAY, physician, educator, and medical investigator, was born in New York on November 2, 1872, and died in Baltimore, at the age of forty-five, on December 27, 1917. He was the son of the late Dr. Edward Gamaliel Janeway and his wife Frances Strong Rogers Janeway.

Dr. Edward Gamaliel Janeway, a distinguished consulting internist in New York City, was a man of large experience in medical practise and in medical teaching. Though he published but little, his opinion was highly valued and commanded the respect and attention of the best medical workers in his city and in the country at large. An accurate clinical observer, he laid great stress upon the control of clinical studies in fatal cases by post-mortem examinations. Direct and simple in his methods he attained to unusual proficiency in clinical diagnosis, especially from the standpoint of pathological anatomy. He was rather taciturn, and was scrupulously honest with himself and with others. Like many men who are diffident by nature, he may have seemed outwardly austere when inwardly he was full of human sympathy and affection. Strongly objective in tendency and with relatively little interest in, or patience with, mere theory, he was unwilling to go beyond ascertainable facts, and preferred to confess ignorance rather than to assume a knowledge that he did not possess. His reputation grew with the years, and patients, especially those suffering from rare and puzzling diseases, from all parts of the United States were by their home physicians referred to him for ex-

amination. His example exerted a profound influence upon his son, not only in childhood and adolescence, but also during many years of close professional association in office practise.

Frances Strong Rogers Janeway was the daughter of a minister, and of a mother who was a woman of strong character, of rare spirit and of considerable artistic talent. From his mother, Theodore Janeway inherited charm of manner, a kindly tolerance, and a warm love for all mankind.

During his boyhood in New York City, and especially in the summer vacations, Theodore Janeway became acquainted with William K. Prentice, a boy a year older than himself, and the acquaintance grew into a friendship and intimacy that lasted throughout his life. Each regarded the other as his best friend, and in riper years the professor of Greek at Princeton and the professor of medicine at Johns Hopkins continued to prize highly this relationship.

After preparation at Cutler's School in New York, Theodore Janeway at the age of sixteen entered the Sheffield Scientific School at Yale, graduating in 1892 with the degree of Bachelor of Philosophy. Like many others who attended this school, he profited much from the influence of Chittenden, the professor of physiological chemistry, an influence that may be discernible later in his career in the interest he manifested in disorders of metabolism. As a youth, he is said to have been sensitive and high strung, interested in everything, impressing his companions with his alertness and the extraordinary activity of his mind. Though agile and fond of games, his rather delicate constitution limited his participation in college athletics. He early evinced an interest in public speaking. In the debating society to which he belonged as a boy, it was obvious that he possessed the gift of simple, lucid and powerful expression. This stood him in good stead when he became a teacher in the medical schools; in medical societies, and in campaigns for public betterment, too, his addresses were characterized by clearness, force, and refinement. He had a feeling for the proper use of words and an ability in combining them that one could wish were more common to men of science. His natural endowments, his early associations, and his college training all contributed to make his choice of a career in medicine a wise one.

Janeway entered upon his undergraduate medical studies at the College of Physicians and Surgeons of Columbia University, and obtained the degree of Doctor of Medicine in 1895. After graduating he served as interne at St. Luke's Hospital. In his medical studies, he exhibited unusual industry and enthusiasm, and from the beginning appreciated the significance of the scientific method in medicine and realized the importance of a broad training in the natural sciences and in the preclinical medical sciences as a foundation for the best type of clinical work.

Dr. Janeway's potential ability as a teacher could not long go unrecognized. In 1898, he was appointed to an instructorship in medical diagnosis in the reorganized New York University and Bellevue Hospital Medical College; later, he was given a lectureship there, continuing his work in this institution for some eight years. It was a time of transition from an older to a newer type of medical teaching and of hospital work in New York City and he and his father, experiencing the difficulties that are common to campaigns of reform, did their best to overcome the obstacles that impeded progress in the change of policy. It was during this

period that Dr. Janeway wrote his book entitled "The Clinical Study of Blood Pressure" and devised the special form of apparatus that bears his name for the determination of blood pressure in human beings. He strove while carrying on his other work to introduce important reforms in the out-patient department of the hospital. In his teaching, he discussed the symptoms and signs upon which diagnosis is based in the light of pathological physiology, took pains to discover the etiological factors, as far as possible, in each case that he studied, and emphasized the importance of tracing the pathogenesis of a disease-process. But conditions in the college did not improve as fast as he hoped they might, and he decided to resign his position rather than to continue in work that could only be unsatisfactory to him.

Despite the severance of his connection with the medical school in which he first taught, he was afforded ample opportunity for the continuation of clinical studies by the material at the City Hospital on Blackwell's Island where he was visiting physician, and by that of the large clientele at his father's office. His friend, Dr. Horst Oertel, the pathologist at the City Hospital, was a congenial co-worker, and students of the College of Physicians and Surgeons, in optional courses, profited much from the clinics and from the demonstrations of pathological material in this hospital. In 1907, through Dr. Janeway's influence, Mrs. Russell Sage endowed the Russell Sage Institute of Pathology with the object of promoting research work at the City Hospital, and Dr. Janeway himself acted as secretary and treasurer of the institute. Here much good work was accomplished, though four years after the foundation of the institute, Dr. Janeway was impelled to resign his position as visiting physician to the City Hospital because of his strong feeling that the commissioner of charities was not sympathetic with the scientific work conducted at the hospital in cooperation with the institute.

In 1907, Dr. Janeway was made associate in medicine at Columbia University, and two years later at the age of thirty-seven, he became Bard professor of medicine in the same institution. The duties of this important chair, together with his work at the Presbyterian Hospital where he now became visiting physician, taxed his strength to the utmost, for, in addition, he continued also to carry on a private practise. The burden steadily increased during the next five years and in 1914 he was forced by ill-health to interrupt his work in order to recuperate.

In this same year, 1914, the General Education Board had set apart a million and a half of dollars, known as the William H. Welch Endowment for Clinical Education and Research for use in the Johns Hopkins Medical School in Baltimore on the condition that three of the principal clinical chairs should be placed upon a so-called "whole-time" basis. The professors at the head of these three departments were to give their whole time and energies to the work of their departments, and were not to supplement their salaries by fees from private practise; if private patients were seen, the fees collected were to go to the treasury of the institution. The chair of medicine, which had been made famous by Professor William Osler's occupancy up to 1905 was included in the reorganization. Though the two men who had led the work in internal medicine in the school from 1905 to 1914 after Dr. Osler's removal to Oxford were sympathetic with the aims of the reorganization, neither of them was able, owing to the exigencies of external circumstances, to accept the professorship of medicine under the new conditions. The medical

faculty offered the "whole-time" chair to Dr. Janeway, and he, after careful consideration, accepted it. Though the relinquishment of private practise meant a large financial sacrifice to him, and removal to Baltimore entailed separation of himself and his family from the great city in which he had thus far spent his life with all its personal relationships and its special cultural opportunities, Dr. Janeway saw how great the opportunity was and rejoiced that he could avail himself of it. He found at the Johns Hopkins Hospital, of which he became the physician-in-chief, a medical clinic organized largely in accord with his ideals for the care of patients, for laboratory work, for teaching and for investigation, alongside of other clinics similarly developed, and associated with strong departments for the promotion of the preclinical sciences. Bringing with him Dr. H. O. Mosenthal, interested in metabolic studies, as associate professor, he retained, either on his "whole-time" staff or on an associated "part-time" staff, nearly all of the workers already in the department, and quickly made the readjustments necessitated by reorganization on the "whole-time" basis. In this congenial atmosphere, where his work could be carried on with a minimum of friction, he had every expectation of a long period of satisfactory hospital practise, of well-organized departmental teaching, and of leadership of a group of able young men in quiet scientific productivity. It was tragical that the period allotted to him proved to be so brief, but in his three years of service in Baltimore he made a deep impression, winning the respect and esteem of colleagues, of pupils, and of the community at large. The authorities of the medical school, though deeply regretting a loss that seems irreparable, may always congratulate themselves on the choice of their first "whole-time" professor of medicine, a man who combined large clinical experience with unusual teaching ability and with capacity for productive scientific study, and one who was content to give his whole time and energies to the work of the institution recompensed by an academic salary, by large opportunity for service, and by joy in the work—a pattern that the reform movement in medical education during the past three decades has been trying to construct.

At Johns Hopkins, Professor Janeway helped to plan a new building for the Hunterian Laboratory for Experimental Medicine, improved the facilities for metabolic studies, fostered researches in the heart station, and secured a substantial increase in the endowment for studies in tuberculosis known as the Kenneth Dow Fund. He was active in the Johns Hopkins Hospital Medical Society, was interested in the Historical Club, and acted as president of the Laennec Society for the Study of Tuberculosis.

Dr. Janeway was a member of the Medical Reserve Corps of the U. S. Army, and was the internist of the unit organized by the Johns Hopkins staff for work in France, now Base Hospital No. 18. When this unit was ordered abroad, he prepared to go with it, but at the last moment his place was taken by Dr. T. R. Boggs, Surgeon-General Gorgas having decided that Dr. Janeway's experience and powers could be used to greater advantage in his own office in Washington. As assistant to the Surgeon-General, Major Janeway went on active duty on June 30, 1917, and with the help of his successor at Columbia, Major Warfield T. Longcope, who acted as his chief assistant, undertook a very important task for the army, namely, the organization of that part of the medical work that had to do with diseases of the heart and

vessels. He first prepared a comprehensive and valuable circular defining the proper methods of examination of the cardiovascular system, the requirements for unconditional acceptance and the disqualifications for active service. He then organized groups of specialists, who, in conjunction with the members of the Tuberculosis Boards, made examinations of the cardiovascular system of the entire National Guard, and acted as consultants with the examiners of the drafted men in the hospitals at the cantonments. The examinations thus made have resulted in the rejection of thousands of men who were totally unfit for active service, but who would otherwise have been accepted, and in the acceptance of many normal men who would otherwise have been rejected. Major Janeway next selected from all parts of the country internists whom he recommended for the chiefs of the medical services of the cantonment hospitals. After this, he instituted, under the direction of Major Seale Harris, a circularization of the internists of the entire country with the object of obtaining suitable men for places of responsibility, and younger men for certain special services. At the time of his death, he was engaged in organizing three mobile medical units, one in the east, one in the center of the country, and one in the west; these units were intended to move from one hospital to another, assisting on the medical services in times of emergency. He had outlined plans, too, for a special hospital for the care and treatment of cardiac diseases and for investigations of military importance to be used with the United States troops abroad. This sketch of Dr. Janeway's work for the army, based upon a memorandum prepared at the Surgeon-General's office, may be supplemented by a word of personal appreciation from the Surgeon-General himself, who says: "Dr. Janeway was an unusually good executive and his loss to our office and his country was very great. I shall find it very difficult to replace him. I came to know him quite well personally, on our inspection trips, and I was very much attracted by his personality; he was one of the best all-round men that I ever met." The record of his six months, service in the Surgeon-General's office gives some idea of the speed and tension of his work. During the autumn months, in addition to this work, he kept in touch with his department in the medical school and still held some of his clinics. It is to be feared that overwork lessened his resistance to infection. He contracted pneumonia, developed a pneumococcus septicemia and died after an illness of six days. We must think of him, therefore, as one of those who sacrificed their lives for their country in the great war.

Dr. Janeway's clarity of mind, his depth and range of vision, and his sanity of judgment made him a wise counsellor, not only of patients but also of institutions. This was very evident by the respect shown for his opinion by the faculties of the schools in which he taught, by the councils of medical organizations like the Association of American Physicians and the American Society for the Advancement of Clinical Investigation, by the Surgeon-General of the army and his associates, and by the boards of directors of scientific institutions of which he was a member. Of the latter, especial mention should be made of the board of scientific directors of the Rockefeller Institute for Medical Research. To this board he was elected in 1911 as successor to the late Dr. Christian Herter. These two men were the representatives of scientific internal medicine in the board and the service they rendered in shaping the ideals and in planning the

activities of this great institute of medical research were very important. Janeway's idealistic temperament, his firm belief in the method of science as applied to the problems of clinical medicine, his wide knowledge of theory and thorough technical training, his large experience in actual practise, and, above all, his well-developed critical faculty, made him a most helpful and sound adviser in the field that he represented in this board, and in the other advisory boards to which he belonged.

Professor Janeway's original inquiries were related especially to diseases of the circulatory apparatus and to disturbances of metabolism. His researches upon blood-pressure and upon renal function will be especially remembered. Besides his monograph on "The Clinical Study of Blood-Pressure" (1904), he contributed to the medical journals some twenty important articles upon the subjects in which he was interested. Several of these appeared in the *Archives of Internal Medicine*, of the editorial staff of which he was a member. During the last years of his life, he was engaged in writing a treatise on "Diseases of the Heart and Blood-Vessels." He had prepared a complete syllabus of the volume and all internists must regret that the production of the monograph has been prevented by his untimely death.

Besides the recognition that had come to him in the form of academic appointments and the other posts of responsibility that have been mentioned, two honorary degrees had already been confered upon him, that of Master of Arts at Yale (1912) and that of Doctor of Science at Washington University, St. Louis (1915). Had he lived, there can be no doubt that he would have received many other honorary degrees. Very few men of worth are insensible to the acknowledgment of that worth by those whose judgment they know to be valuble; it is well that they should not be. Dr. Janeway's character and ideals were such that he cared little for other support:

> La gloire
> Ne compte pas toujours les voix;
> Elle les pèse quelquefois.

The support of those who have the good of internal medicine most at heart in this country Dr. Janeway undoubtedly had. But this was not indispensable to him as motive, his desire to further the science of medicine for the good of suffering mankind was to him an impelling force that was all-sufficing.

In his family life Dr. Janeway was particularly fortunate. Married in 1898 to Eleanor C. Alderson of Overbrook, Pa., he found in his wife a companion who shared his ideals, who supported him through difficulties, and who was prepared to make whatever sacrifices were necessary to permit the full employment of his energies to the attainment of any good that he deemed worthy of his effort. She and their five children, his mother, and two sisters survive him. To his home, his older friends and his students, of whom he also made friends, were cordially welcomed. He had a true and delicate ear for music and though he had no extensive musical training found pleasure and recreation in playing the violin in the family circle. Those who knew him best were charmed by his deep and ready sympathy, his quick and thorough understanding of others, and his unselfishness and generosity. His life will be an outstanding example to influence young men entering upon a career in medicine. His death, at a time when, in the ordinary course of events, he might well have been expected to give at least twenty years more of the highest kind of service to his country and to science, is one of those losses that mankind laments,

finds difficult to understand and to bear, and must some time learn how to prevent.

LEWELLYS F. BARKER

THE NEED FOR ORGANIZATION OF AMERICAN BOTANISTS FOR MORE EFFECTIVE PROSECUTION OF WAR WORK[1]

OUR country is now passing through one of the most critical periods in its history and the manner in which we shall emerge from this turmoil will depend on how successfully we can apply a lesson now being taught us by our arch-enemy Germany—the value of organized effort. The central empires are surpassed by the allies in man-power and in economic resources of every kind. But Germany is a marvel of organization and she has so thoroughly coordinated all her activities, especially those relating to war, that she is able to throw every ounce of her power in any direction desired. On this account she absolutely dominates her allies, and to this she owes her military efficiency and her powers of endurance. The United States and the entente nations are rapidly learning this lesson and, although the daily press is filled with stories of inaction and of clashing authority and with reports of investigations of alleged incompetency, still we see everywhere about us the evidences of greater cooperation, of standardization in production and of more thorough organization of all our activities—signs which augur well for future victory, for it is only by beating Germany at her own game that we can hope to win this war quickly.

The increase of efficiency by organization is no new discovery of the Germans or of this time of war. The remarkable development of American industry has been due in a large measure to the capacity of our business men for organization. But Americans are independent beings and have feared the evils of excessive organization—the curbing of personal freedom and initiative, and the reduction of the individual to the level of a cog in a smoothly running machine. The evils arising from over-organization are probably more to be deplored than those due to under-organization. Neither extreme develops the highest type of human being nor makes for lasting human progress. But in these times of stress we must not hesitate—the necessity for more thorough organization in all lines is forced upon us, and botanists, together with other scientists, must heed the call. This is a scientific war and science, not brute-force, must win it. Scientific workers become individualistic, and pure research naturally shuns the publicity of organization, but many lines of research and applied science in general are as much benefited by cooperation as is any industry.

Nowhere is the need for organization greater than in connection with the food supply, the importance of whose problems has been pressed upon our attention by the prevailing high prices and by the shortage of sugar and other important food stuffs. The relation of botanists to food production is a vital one and as botanists we now carry a grave responsibility.

We also face a wonderful opportunity. In the past botany has failed to receive the full measure of popular appreciation it deserves, though no subject is more vitally connected with human welfare and human progress than the study of plants. Botany is one of the oldest of human studies, yet we have seen other sciences of smaller ac-

[1] Invitation paper before Section G of the American Association for the Advancement of Science, in joint session with the Botanical Society of America and the American Phytopathological Society in a symposium on War Problems in Botany, Pittsburgh, December 29, 1917.

tual value to mankind overtake and pass it in public esteem and in public support. Does not the fault lie with botanists themselves? Have they not been too prone to lose themselves in their scientific studies and to forget or to neglect their human responsibilities? Botanists have allowed subjects like bacteriology, agronomy and horticulture to struggle up largely unaided and to win independent status so that to-day many specialists in these fields of botanical work do not recognize themselves as botanists and yield no allegiance to the mother science. It is not so with chemistry. Every worker in the chemical field calls himself a chemist, no matter what his special line may be, and chemistry is written large in public esteem as a great and broad and practical science. On the other hand the average person has little conception of what botany really is, and of its practical value to mankind. We can not expect the federal and state governments to fully recognize the great value of botanists to the nation when botanists themselves are at a loss to know how they may best serve in this time of crisis, and when they have allowed almost a year of war to pass without taking a prominent professional part in war activities.

This period of national danger presents to botanists an unrivaled opportunity to win the full recognition our science now lacks, to win it for all time, and also to serve the nation and help win the war, by showing what botanical research and the application of botanical knowledge can do in solving the problems of increased food production. This is our special field and the problems presented to us are so varied that all divisions of botany must take part in the work.

Time is pressing and the emergency demands that we speed up in our output of accomplishment in lines of immediate value in the war. This means mobilization of our botanical forces so that all workers capable of rendering assistance may be utilized; it means organization under wise leadership that our efforts may be properly correlated and thus rendered most effective; it means concentration on the problems most immediately important and if necessary the laying aside for the moment of the particular lines of research which now chance to interest us, if by so doing we can serve our country more effectively. At this time when we are facing a serious depletion of our ranks due to the call of many of the younger botanists to military service, how essential it is that those of us who are left should see to it that botanical work is not disrupted, that personal and professional interests are laid aside if need be, and that our efforts are wisely coordinated and properly distributed. As an example of the type of cooperative service I believe we should undertake, I shall discuss this afternoon one phase of botanical work now being organized, which aims to assist in increasing the food production of the United States and which is marked by organized cooperation on a large scale.

Two imperative demands have been made on the American people this year in connection with the food supply. The first of these is—*raise more food, increase food production.* Dwellers in towns and cities were bidden to enlarge their gardens, and we have responded by spading up our back yards and by plowing vacant lots. There has been much poorly directed effort like that of the patriotic citizen of New Jersey who, after watching his neighbor use a crow bar to make holes for his bean poles, went home and made similar holes into which he dropped his beans and buried them for all time; yet altogether the backyard gardens have materially increased our supply of vegetables. Farmers were

bidden to increase their acreage, and have done this, so far as they were able. But it is clear that if the food supply is to be increased it must be accomplished largely by increasing the yield per acre, rather than by increasing the acreage; and the botanists of America must largely assume this responsibility. The adaptation of crops to soils and to climate, proper crop rotation and general improvement of cultural methods, the development and introduction of better seed and of improved varieties, the checking of ravages of plant diseases—these and many others are botanical problems in the solution of which botanists of every type must have a share.

The second demand on the people this year in connection with the food supply is —*save food, prevent waste.* We find here the problems of the pantry and the kitchen, of storage and transportation, of the preservation of perishable crops and foods—problems many of which are botanical or have botanical aspects.

There are no richer fields of scientific research to-day than the varied economic problems now presented to the botanists of America, and none fraught with greater possibilities of honor to the worker and of benefit to the nation, and to no class of botanists is the call stronger or the duty greater than to the plant pathologist. By preventing the ravages of diseases on growing crops he increases food production, and by checking the development of the organisms of decay on food material in transit and in storage he prevents food wastage. We are now saving food to feed our allies by instituting wheatless days and meatless days, and days and meals less this and that. Under present conditions this procedure is necessary and the curbing of our appetites has its hygienic value. But how much more pleasant it is to save food by curbing plant diseases, which can and should be done much more extensively than is now the case.

I shall not attempt to demonstrate the importance of the work before pathologists by citing figures giving estimates of losses due to plant diseases. I will only remind you that there is no economic plant which has not its fungous enemies, each of which takes its toll of the growing crop, while many plants count these enemies by the dozen or the score, so that the total aggregate loss is staggering. But the consumer does not appreciate this fact, and even the grower himself is indifferent. Both are so accustomed to a certain amount of loss from disease and storage rot that they accept it as a matter of course, not realizing that much of the loss is easily preventable. Since the symptoms of disease in plants are ordinarily much less striking than those of disease in animals, or even than the ravages of the crops by insects, the average farmer may not recognize the presence of disease in his grain field until the loss amounts to 15 or 20 per cent.; less than that is overlooked or charged to the weather. It may require the loss of a third to half his crop to arouse him to action and to the adoption of proper control measures.

So we see that the plant pathologist has a double duty to perform. He must first devise means for controlling plant diseases; he must then carry these control measures to the farmers and arouse sufficient public interest to secure their regular and effective adoption. The second of these functions is no less important than the first, and frequently is much more difficult of accomplishment. The scientific aspects of the problem may be solved when the pathologists have devised effective means of control, but the economic aspects are not solved until the disease in question is conquered and the losses reduced to a negligible amount by the general adoption of control measures by the growers.

Plant pathology has had a magnificent development during the last 20 years, and yet only a beginning has been made. As yet there are few if any plant diseases which we can say have been conquered and practically eliminated from consideration as the cause of any considerable economic losses. There is no record that any plant disease, after having once thoroughly established itself over a considerable territory, has ever been eradicated. Nor is there any plant disease which is to-day being effectively controlled in practise except in limited areas, no matter how simple or how effective the control measures are. Remedial measures are known for many diseases, and there are many whose complete control is easily possible, but the public has never been aroused to the necessity of thorough and persistent application of the remedies. Pathologists have not completed their work. We need more propaganda to instruct and to arouse sentiment in favor of disease control. We need public control of plant sanitation, as we have a public health service for human beings. We need laws requiring treatment of grain for smut as we now have laws requiring smallpox vaccination. At this time when the world is hungry, the producer of food has no more right to jeopardize or to neglect the health of his crop than you or I to endanger the public health. And the plant pathologist, as the guardian of the health of food crops, should rank in importance with the medical practitioner and the public health officer. We have come to the time when plant pathology should be carefully reorganized as a public service and when pathologists should scrutinize all phases of their work and see to it that no important part is neglected. The need for this action has been increased by the world war but it would have become necessary soon had the world remained at peace.

In glancing over the history of plant pathology we see that the first phase of the subject to develop was research work on the diseases—study of the life histories of the causal organisms, and of their relations to and effects upon the host plants. Perhaps control measures were also worked out, but with the publication of his paper the investigator dropped the subject without making sure that the results of his investigation were carried to the grower. Much valuable work of this character has been severely criticized as being impractical, some critics even now going so far as to urge that research work be suspended entirely for a time and attention concentrated on the practical application of present knowledge.

More recently there has developed a second phase of phytopathological work, *i. e.*, extension work or the actual carrying of the results of investigation to the farmer, and the practical demonstration to him of control methods, thus bridging the gap between investigator and grower. Great progress has already been made in this field and plans are now maturing for still further development. This is a line of work of the greatest importance, which should be specially pushed at this time in order that the ravages of disease may be effectively checked in those cases where adequate control measures are already known.

There remains a third phase of pathological work, which we may call the intelligence service, which is fundamental in importance and is contributory to the success of both research and extension work. A well-organized intelligence service is a necessary adjunct to every large enterprise. Armies have their scouts and spies, their raiding parties on land and aeroplanes in the air, to keep the commanders informed of the movements and plans of the enemy. Great business houses have their domestic

and foreign representatives and correspondents. Governments have their consuls, attaches and secret service. Human medicine has its public health service to guard the public health, to report on disease and to attend to sanitation. In the same way plant pathology needs its intelligence service, its public-health service for plants, which shall assist both research and extension pathologists in waging war on plant parasites.

The Plant Disease Survey of the Department of Agriculture is now organizing such a service, and I believe that it will prove to be of great value. By accumulating a large body of authoritative information on the geographical distribution and annual prevalence of plant diseases, together with careful estimates of the losses caused by them we shall assist in clarifying the disease situation in the various parts of the United States and in delimiting the problems involved. With these data at hand pathologists will be enabled to choose their research problems wisely and to concentrate their energies on those questions which are most pressing in their respective states. The Plant Disease Survey will also aid the research pathologist by furnishing him the information he needs during the progress of his studies, such as data on the nature and character of diseases in the field and on the relation of diseases to climatic and other environmental factors. We shall also assist the extension pathologist by informing him of the prevalence of diseases, of regions where losses occur and where demonstration work is most needed, of the varying effects of control measures in different regions, and of other matters of importance in planning and carrying on his campaigns of education and of disease control.

Up to this time the gathering of field data on plant disease has been left to the individual investigators who have gone into the field during the progress of their studies to collect the information they needed. They have thus been called away from the main features of their problems in order to collect data which should more properly be furnished them. Extensive collection of field data by an investigator beyond the time needed to keep him in touch with all phases of his problem, is time lost. He frequently realizes this and reduces his field work to a minimum, thus handicapping himself in his research work by an insufficient body of field data.

I shall not attempt at this time to discuss in detail the plans of the Plant Disease Survey. We purpose to organize this work on a broad basis, to coordinate all existing efforts along this line, to systematize the collecting of information and to make all data thus gathered immediately available to all to whom it may be of value. We have already associated with us as collaborators and local leaders the pathologists at almost all the state experiment stations, and we hope to extend this system of cooperation until we shall include in our organization all pathologists and all others able and willing to contribute reliable information on plant diseases. We also hope to develop and to maintain in the field a corps of trained observers who will supplement the reports of our correspondents and make detailed surveys in special regions and for important diseases. Much work must be done before our plans are fully developed. This will require time, general assistance on the part of botanists, and larger funds than are yet available.

Let me emphasize the fact that the Plant Disease Survey is distinctly a cooperative project. It is not an end in itself but aims to serve all pathological workers of the country by freely supplying all available data which can aid them in their work.

The success of this movement will depend on the extent to which pathologists cooperate in contributing to the common store of information. No matter how absorbing your present work may be each one of you as a botanist can aid us by reporting on the disease situation in your immediate neighborhood. This report may be made to our collaborator, the pathologist at your state experiment station or if preferred it may be sent direct to the central office of the survey at Washington. We shall be glad to discuss with you individually the best means of making your cooperation effective. Not only will the information you send us be of value, but your active support will assist us in our efforts to unite all pathological workers in one great cooperative service which will strive to do for our food crops some of the things which the public-health service does for us as human beings.

In this paper I have endeavored to point out the grave responsibility which rests on us as botanists during this world war. This responsibility is a challenge to us as patriotic Americans because we possess special knowledge and training which the nation needs, and to which she has a right during her hour of peril. I have emphasized the growing need for cooperation as with added responsibilities and reduced numbers we strive to meet the increasing demands of the immediate future. I have presented to you as an example of such cooperative effort the work of the Plant Disease Survey and have urged you to join us in our plans for strengthening phytopathological work. In closing let me outline two movements of fundamental importance which I believe botanists should immediately undertake.

First, let us arouse the public to an appreciation of the important part which botany must play in the agriculture of the future. Increased acreage and improved facilities for distribution of farm products are not sufficient to ensure the world an adequate food supply. Increased production must be the result of scientific research, and the average farmer must be taught the value of the prompt application of the results of research to the improvement of agricultural methods. And not only must the farmer be educated but propaganda must be carried on with the business man and the legislator that the botanist may be properly appreciated and his work supported. Botanical work, even of the most fundamental importance, is apt to lack those striking or sensational qualities which chain public attention, and unaided draw large appropriations from our lawmakers. Let us then teach our students the human significance of the study of plants, and send them forth as missionaries. Let us by spoken and printed word and by demonstration strive to instill into the public mind a greater respect for botanical research and a more ready acceptance of its results, thus doing our bit toward ensuring both scientific and material prosperity in the future.

And second, let us immediately organize to increase our efficiency. A serious crisis requires that maximum power be exerted to avoid catastrophe. Hence discipline and organization under aggressive leadership must replace independent uncorrelated effort. I propose therefore that the Botanical Society of America, the American Phytopathological and other botanical societies now in session at Pittsburgh appoint committees of experts in the various botanical fields to effect the necessary organization and to provide the leadership required. These committees shall consider the relative importance of the problems falling in their respective fields, whether or not those problems are now under investigation.

They shall mobilize the available botanical forces of the United States, especially those workers who are now engaged in war emergency work, and by careful distribution of the work and by correlation of effort seek the early solution of those problems which are of greatest immediate significance. The support which any movement receives and its effectiveness depends largely upon its leaders, hence these committees must be wisely selected and composed of aggressive men of action whose wisdom and personality will command the allegiance of their fellow botanists.

Many may doubt the wisdom of the plan I have suggested and feel skeptical of the results to be obtained through committees. I do not care what plan is adopted—the essential thing is action. No one can longer doubt the seriousness of the path which lies before this nation or question the imperative need for the greatest service botanists can render. American manhood is preparing to suffer and die upon the battlefields of Europe, and we who stay at home must not fall one inch short of the greatest accomplishment of which we are capable in providing the food and supplies our soldiers need. Any failure on our part means prolonging and intensifying the frightful agony. Have we thus far done our best as botanists? Are all botanists working with the single purpose of doing their full duty in this war? Does not unpreparedness still characterize us as a class? Have we not in general continued our pre-war activities, thinking the war would soon be over, or waiting for some mighty call to draft us into service? Let us wait no longer, but call *ourselves* to service. There is time to prepare for an effective campaign during 1918; there are many botanical questions of paramount national importance which should be solved this coming year; and there are many botanists who have assured me that they will gladly turn aside from their present work if they can serve more effectively elsewhere. Let us organize for more effective service that we may attract all available workers to our ranks and enlist every botanist in war emergency work. Let us develop a logical and comprehensive plan of campaign which shall supplement the plans of federal and state departments of agriculture and receive the united support of American botanists. Let us wisely correlate our efforts that we may increase our immediate accomplishment and make of American botanists a powerful army of trained scientists moving forward with power and precision in the service of the nation and the world.

G. R. LYMAN

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

SCIENTIFIC EVENTS

ENGLISH VITAL STATISTICS

THE Registrar-General's return of vital statistics for 1916 in England and Wales, according to an abstract in the London *Times*, shows a reduction of 4.5 in the marriage rate as compared with that for 1915, when it was exceptionally high, and the lowest death-rate of children under one year ever recorded.

The report refers to the difficulties of framing estimates of population owing to the war. These have become so formidable that it is no longer possible to put forward figures otherwise than as rough approximations. As the estimates (except those for birthrate and marriage-rate purposes) are for the civil population only, enlistment has been treated as equivalent to emigration. The estimated civil population of England and Wales was 34,000,000 in 1916 (15,000,000 males and 19.000,000 females).

The marriages during 1916 numbered 279,846, a rate of 14.9 persons married per 1,000, 0.6 below the average rate of the decade 1901-10. The marriage rates for 1916 were 49.6 for males and 41.0 for females, the lowest hitherto

recorded for females, and the lowest but one for males.

We have thus (the report states) the curious phenomenon of an unprecedentedly high marriage rate in 1915 succeeded by an almost unprecedentedly low one in 1916. The flood of marriages which set in with the second quarter of 1915 did not ebb until a year later, so that considerably more marriages were registered in the first quarter of 1916 than in the corresponding quarter of any previous year. These violent changes are no doubt the direct consequence of the war, and appear in 1917 to be giving place to a less abnormal state of affairs.

There was in 1916 a notable increase in the proportion of marriages of young widows. The population of widows under thirty years of age must have been greatly increased as a result of the war. The marriage prospects of spinsters were decreased for two reasons—there were fewer marriageable males in consequence of the losses of unmarried combatants, and more marriageable females in consequence of the losses of married combatants.

In proportion to the total population, the birthrate was 20.9 per 1,000 living. The reduction of natality accompanying the war only amounted to 12 per cent., whereas in Germany the fall was reported to have been 40 per cent. in the two years 1915 and 1916.

The excess of births over deaths was 277,303. The number of fatal casualties incurred by English and Welsh troops during the year, says the report, must be very much lower than 277,303, and so the increase in population must have continued. The German statistics record 1,331,000 deaths in 1916, apparently exclusive of at least the great majority of fatal war casualties, as against 1,103,000 births; and the Hungarian figures are for deaths "not in action" 428,057, as against 333,551 births.

The deaths of 508,217 persons were registered, a rate of 13.3 per 1,000. The deaths of children under one year of age numbered 71,646, or 91 per 1,000, the lowest rate ever recorded. Eighty-eight reputed centenarians died, 70 of whom were women.

STANDARD TIME AT SEA

Following the action of the French navy the Lords of the Admiralty summoned a conference of representatives of the various government departments and scientific societies interested, to consider and report upon the desirability of establishing a standard time at sea in the British naval and merchant services. The report of this conference has now been presented to the Lords of the Admiralty, and the *Geographical Journal* publishes a summary of its recommendations. The conference had the advantage of the assistance of the French hydrographer, M. Renaud, accompanied by Lieutenant de Vaisseau Moreau, of the wireless staff of the French navy.

The principal business of the conference was to consider the desirability of extending to the sea the system of time zones now widely adopted on the land; a system whose advantages have long been recognized as highly conducive to precision and certainty in the interchange of telegrams, the arrangements of train and postal services, and in many other departments of life. Until recently a ship at sea was a law to itself; and although ship's time was usually more or less adjusted to apparent time at noon each day, there was no certainty that the time of a message despatched from the ship or of an entry in the ship's log could be translated into Greenwich mean time. The conference was of opinion that the establishment of zones at sea (outside territorial waters) corresponding to the time zones on land is the most practical method of obtaining uniformity in time reckoning at sea; and after examination of the "Planisphère des Fuseaux Horaires" prepared by M. Renaud (of which a copy has for some time been displayed in the Map Room of the Society) it recommended the adoption of the boundaries of the zones as defined therein and now in use in the French navy. It also expressed a hope that those countries which have not yet adopted the system of hour zones will in course of time conform to this system. The question of summer time was considered, and the conference was of the opinion that there was no advantage in introducing summer time on the high seas.

Only in this and in one other respect did the conference propose any change in the French system. The second change is one of nomenclature only, but it is of some importance. In the French system the time zones are numbered eastward from 0 to 23 hours, which, while in many respects convenient, has the disadvantage that it does not give without ambiguity the reduction from the time of any zone to the time and date of Greenwich. The conference therefore recommended that

The zone extending from $7\frac{1}{2}$ degrees east to $7\frac{1}{2}$ degrees west of the meridian of Greenwich should be the Zero Zone. The zones west of the Zero Zone should be described as Plus 1, Plus 2 . . . up to Plus 12 for that part of Zone 12 lying east of the date line (*i. e.*, the line described in the Admiralty Sailing Directions based on the 180th meridian, on crossing which from east to west the date must be advanced or put back one day respectively), and the zones east of the Zero Zone should be described as Minus 1, Minus 2 . . . up to Minus 12, for that part of Zone 12 lying west of the date line.

To ensure the application of the above scheme the conference considered it desirable

(*a*) That the alteration of the time of the clocks in ships should always be one hour, and be invariably recorded in the ship's log; but the instant at which the clock is altered need not necessarily be that at which the ship passes from one zone to another.

(*b*) That the zone description, *i. e.*, the correction required to obtain Greenwich time, be always plainly shown on the clocks, either by labels or otherwise.

(*c*) That in all entries in ship's records, whenever a date is given it should be accompanied by the zone description; and that in all official communications and correspondence, when a time is given the zone description should be added.

(*d*) That for all regular meteorological observations the ship's clock time should be used. That, as a rule, all self-recording meteorological instruments on board ship (which it would be difficult to adjust continually for zone time) should keep Greenwich time; the zone description should be entered daily on the record.

MEETING OF PETROLEUM GEOLOGISTS

AT a meeting of petroleum geologists held in Oklahoma City, Oklahoma, on February 15 and 16, the American Association of Petroleum Geologists was formed. The new organization was largely a change of name and widening of scope of activites of a highly successful local organization, the Southwestern Association of Petroleum Geologists, which has been in existence for three years. Over 100 geologists from various parts of the country were present. The widespread interest in petroleum geology and the large number of men now engaged in the profession was thought to warrant a national organization and the momentum gained by the local body assured the success of such a step.

Thos. M. O'Donnell, representing the Federal Fuel Administration, addressed the meeting and brought assurance from Washington that there need be no fear of hampering interference from his department as long as the oil men of the country did their patriotic duty and exerted their utmost efforts to maintain an adequate supply of oil to meet war demands.

An evening session was entertained with a talk by Professor James F. Kemp, on the geologic problems connected with the New York water supply, illustrated by stereopticon slides. The same session was addressed by Dr. I. C. White, who gave an interesting account of the huge gushers of Mexico. Dr. White's connection with the Doheny interests in Mexico gave weight and interest to his remarks on this subject through the courtesy of Mr. E. L. Doheny the moving pictures of the Huasteca Petroleum Company's wonderful well, Cerro Azul No. 4, were exhibited.

Professor R. D. Salisbury, of the University of Chicago, attended the meeting and was greeted by some twenty students of his department, who are now interested in the oil business of the southwest.

The list of papers presented at the several technical sessions included:

The distribution of underground salt water and its relation to the accumulation of oil and gas, by Roswell H. Johnson, Pittsburgh, Pa.

The oil fields of Cuba, by E. L. De Golyer, New York, N. Y.

The relations of former shore lines to oil accumulation, by A. W. McCoy, Bartlesville, Oklahoma.

The bend formation as a source of oil in northwest Texas, by W. E. Wrather, Wichita Falls, Texas.

Contributions to the stratigraphy of the red beds, by D. W. O'Hern, Oklahoma City, Oklahoma.

Papers were read covering points of geologic interest brought out by the past year's development as follows: the Gulf Coast, by Alexander Deussen, Houston, Texas; Kansas, by R. L. Moore, Lawrence, Kansas; Kentucky, by J. W. Pemberton, Tulsa, Oklahoma; Northwest Louisiana, by Mowery Bates, Tulsa, Okla.

Officers elected for the current year were: *President,* Alexander Deussen, Houston, Texas; *Vice-president,* Dr. I. C. White, Morgantown, West Va.; *Secretary-Treasurer,* W. E. Wrather, Wichita Falls, Texas; and Editor, Charles H. Taylor, Oklahoma City, Oklahoma. The next meeting of the association will be held in Houston, Texas, the exact date to be announced later.

THE RESEARCH INFORMATION COMMITTEE

By joint action the Secretaries of War and Navy, with the approval of the Council of National Defense, have authorized and approved the organization, through the National Research Council, of a Research Information Committee in Washington with branch committees in Paris and London, which are intended to work in close cooperation with the officers of the Military and Naval Intelligence, and whose function shall be the securing, classifying and disseminating of scientific technical and industrial research information, especially relating to war problems, and the interchange of such information between the allies in Europe and the United States.

The Washington committee consists of

(*a*) A civilian member, representing the National Research Council; Dr. S. W. Stratton, chairman.

(*b*) The chief, Military Intelligence Section.

(*c*) The Director of Naval Intelligence.

The initial organization of the committee in London is

(*a*) The scientific attaché representing the Research Information Committee; Dr. H. A. Bumstead, attaché.

(*b*) The military attaché, or an officer deputed to act for him.

(*c*) The naval attaché, or an officer deputed to act for him.

The initial organization of the committee in Paris is

(*a*) The scientific attaché representing the Research Information Committee, Dr. W. F. Durand, attaché.

(*b*) The military attaché, or an officer deputed to act for him.

(*c*) The naval attaché, or an officer deputed to act for him.

The chief functions of the foreign committees thus organized are intended to be as follows:

(*a*) The development of contact with all important research laboratories or agencies, governmental or private; the compilation of problems and subjects under investigation; and the collection and compilation of the results attained.

(*b*) The classification, organization and preparation of such information for transmission to the Research Information Committee in Washington.

(*c*) The maintenance of continuous contact with the work of the officers of military and naval attachés in order that all duplication of work or crossing of effort may be avoided, with the consequent waste of time and energy and the confusion resulting from crossed or duplicated effort.

(*d*) To serve as an immediate auxiliary to the offices of the military and naval attachés in the collection, analysis and compilation of scientific, technical and industrial research information.

(*e*) To serve as an agency at the immediate service of the commander-in-chief of the military or naval forces in Europe for the collection and analysis of scientific and technical research information, and as an auxiliary to such direct military and naval agencies as may be in use for the purpose.

(*f*) To serve as centers of distribution to the

American Expeditionary Forces in France and to the American naval forces in European waters of scientific and technical research information, originating in the United States and transmitted through the Research Information Committee in Washington.

(*g*) To serve as centers of distribution to our allies in Europe of scientific, technical and industrial research information originating in the United States and transmitted through the Research Information Committee in Washington.

(*h*) The maintenance of the necessary contact between the offices in Paris and London in order that provision may be made for the direct and prompt interchange of important scientific and technical information.

(*i*) To aid research workers or collectors of scientific, technical and industrial information from the United States, when properly accredited from the Research Information Committee in Washington, in best achieving their several and particular purposes.

The headquarters of the Research Information Committee in Washington is in the offices of the National Research Council, 1023 Sixteenth Street; the branch committees are located at the American Embassies in London and Paris.

SCIENTIFIC NOTES AND NEWS

THE Geological Society of London has awarded to Dr. Charles D. Walcott, secretary of the Smithsonian Institution, its Wollaston Medal, in recognition of his contributions to Cambrian paleontology. The presentation of the medal was made at a meeting of the society in London on February 15, the secretary of the American Embassy receiving the medal in Dr. Walcott's behalf. The list of eighty-seven men of science who have received this medal since its establishment in 1831 contains the names of five other Americans, Louis Agassiz, James Hall, James D. Dana, Grove Karl Gilbert and W. B. Scott.

PROFESSOR A. N. TALBOT, of the University of Illinois, president of the American Society of Civil Engineers, is head of a board to advise on construction for the War Department, involving, it is said, the sum of over a billion dollars.

MAJOR FRED A. ALBEE has been placed in charge of the hospital to be situated at Islam, N. J. This hospital will consist of seven buildings with fifteen hundred beds and will be used for the restoration of crippled soldiers.

PROFESSOR D. M. FOLSOM, of the department of mineralogy of Stanford University, has been appointed fuel oil administrator for the western states. His jurisdiction will cover Idaho, Montana, Utah, Arizona, New Mexico, Nevada, Oregon, Washington, California and Alaska.

MAJOR SIMON FLEXNER, of the Rockefeller Institute, is conducting at Fort Sheridan, Ill., in conjunction with Major George Draper, an investigation in connection with the prevention of meningitis. Major Edward K. Dunham, of New York City, will visit Camp Lee, Petersburg, Va., for investigation in connection with the treatment of meningitis carriers.

PROFESSOR GEORGE F. SEVER, formerly professor of electrical engineering and acting dean of the faculty of applied science in Columbia University, has been commissioned a major in the Engineers' Officers Reserve Corps, and is now stationed in Washington. He has closed his engineering office in New York City.

CAPTAIN R. J. ANDERSON, of the Geneva Experiment Station, and Lieutenants W. A. Perlzweig, Henry R. Cates and Charles N. Frey, are making a nutritional survey of the army camps situated in the southern states. The survey is part of the work at present conducted by the Surgeon General's Office to determine the character of the food supplied to the American soldiers.

MAJOR J. F. CORBETT has been sent from the Rockefeller Institute to Canada to study the Canadian treatment of returning soldiers suffering from peripheral nerve injuries.

IT is announced that a medical board, consisting of Brigadier General Charles Richard and Major Frank Billings, has been appointed to revise the Manual of Instructions for Medical Advisory Boards working under the Selective Service Law.

Dr. Hermann M. Biggs has been elected a member of the international health board of the Rockefeller Foundation for Medical Research.

Professor G. H. Clevenger has resigned as research professor of metallurgy at Stanford University and is now engaged in directing cooperative experimental work in the U. S. Bureau of Mines, Netherlands East Indies government, Research Corporation of New York and others.

Dr. F. E. Carruth, formerly connected with the chemical division of the North Carolina Experiment Station, has become associated with the Schaefer Alkaloid Works, Maywood, N. J.

Professor Luigi Luciani, of the chair of physiology at the University of Rome, retires at the end of the present academic year, having reached the age limit. He has been a member of the senate and of the national board of public instruction.

UNIVERSITY AND EDUCATIONAL NEWS

Mrs. Russell Sage has given $100,000 to Syracuse University. The fund will be devoted to the direct interests of the John Slocum College of Agriculture, which is named after Mrs. Sage's father.

The new building of the University of Cincinnati College of Medicine was dedicated on February 25, the principal speakers being Major Christian R. Holmes, dean, and Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching. The new medical building was erected and equipped at a total cost of approximately $600,000.

According to the *Journal* of the American Medical Association, the Ontario legislature has granted to the Ontario University for 1918, the following amounts: Western, London, $20,000 for the public health department; $15,000 for the medical department; $15,000 for the arts, and a special grant of $10,000; Toronto University, large grants, including a special grant of $175,000; Queen's, Kingston, $80,000, including a special grant amounting to $25,000.

Lord Balfour of Burleigh, who presided at the recent annual meeting of the Carnegie Trust at Westminster stated that experts had reported favorably on the work accomplished during the past year, especially by research students, whose achievements had been of real use to the nation. Assistance to students, under payment of class fees for the past year, had been again reduced by £3,000 to £26,000, the beneficiaries numbering 2,112. Scottish university incomes from this source had in five years fallen to about half. This was a serious matter for the universities, and it was hoped that Treasury grants would alleviate the position. An encouraging feature of last year was the voluntary repayment of £1,808 by 21 beneficiaries.

Dr. William M. Jardin, since 1910 professor of agronomy, and later dean of the division of agriculture and director of the agricultural experiment station of the Kansas State Agricultural College, has been elected president of the College. Dr. J. T. Willard, professor of applied chemistry, becomes vice-president.

Dr. Harry Clark, who was from 1911 to 1917 an instructor in physics at Harvard University has been appointed professor of physics in Victoria College, Wellington, New Zealand.

The following have been appointed fellows of University College, London: Miss Harriette Chick, D.Sc., assistant to the director of the Lister Institute of Preventive Medicine; Dr. Ernest Marshall Cowell, M.D.., B.S., F.R.C.S., captain R.A.M.C.; Dr. Charles Authur Lovatt Evans, D.Sc., professor of physiology in the University of Leeds, major, R.A.M.C.; Dr. David Heron, D.Sc., secretary to the London Guarantee and Accident Company; Mr. William Howard Lister, D.S.O. captain R.A.M.C.; Mr. Edward Kenneth Martin, F.R.C.S. surgical registrar to University College Hospital, major R.A.M.C.; Mr. Edward Talbot, Paris B.Sc. The following were appointed fellows of King's College. Professor Arthur Dendy, D.Sc., F.R.S. professor of zoology in the Uni-

versity since 1911 (of zoology and animal biology at the College since 1905); Mr. Francis Lydall, 13th Wrangler; special lecturer on Advanced Electrical Engineering at the College, 1910–14.

DISCUSSION AND CORRESPONDENCE

THE AURORA BOREALIS

THE most extensive and brilliant aurora witnessed in central Illinois within the memory of living men attracted unusual attention on the evening of March 7, 1918, at Urbana, Illinois, in lat. 40° 6′ N., long. 88° 13′ W. Although the aurora is only rarely visible here at all, this one reached beyond the zenith.

The aurora first attracted my attention at 9:25 P.M., central time, in the form of a band of white light about 2° wide, extending in an arc from a point on the horizon at about N. 45° W. across the north sky, reaching a maximum altitude of about 20°, approximately due north, and descending at about N. 45° E. Through and beyond this, radiating white bands extending upward, and two rosy areas of about the color of the strontium flame appeared, one about N. 45° E. and 20° above the horizon, the other about N. 10° W. and 25° or 30° above the horizon.

The illuminated area extended rapidly, reaching a maximum at about 9:45 P.M., when it included the entire north half of the sky and overlapped into the south half from horizon to zenith. The main framework consisted of streamers of white light converging toward a point 30° or more south of and below the zenith. These streamers rose vertically from the north point of the horizon and its vicinity, but those rising from the east and west points of the horizon were inclined about 20° from the vertical (toward the south).

The streamers were fairly steady, in large part, extending, multiplying, and fading gradually; but in many parts of the sky there was a nearly continual play of light, in pulsations proceeding swiftly upward along the rays. Occasionally a streamer or a group of streamers brightened suddenly, giving an effect like that of the throwing on of a great searchlight.

Against the background of white streamers the red color expanded in glowing patches, increasing in brilliance as in area. During the maximum brilliance and extent of the aurora, the red was bright from the due east to the due west vertical circles and beyond them, and especially near the zenith (just below it to the north). It was never a continuous sheet of uniform brightness, but appeared brightest in roundish patches, locally streaking out parallel to the white streamers. The red lights pulsated and played up and down over the sky like the white.

About 9:50 P.M., after the aurora had faded slowly for a few minutes, the white streamers shortening to an altitude of 45° or less, the red light concentrated again in two patches, one about N. 45° E. and 20° above the horizon, the other N. 5°–10° W. and 25°–30° high. They varied from 3 to 10 degrees or more in diameter. About 9:55 a third bright red area appeared, about N. 40° W. and 20°–25° above the horizon. It was less perfectly circular than the other two, having a tendency to show brightest and to expand along lines parallel to the white streamers.

About 10:05 P.M. the N. 40° W. and N. 45° E. red areas faded out, leaving a single glowing patch N.–N. 10° W. and 20°–25° above the horizon, which continued to pulsate faintly and grow weaker. The white light had now subsided to a rather uniform sector of the north sky reaching from about N. 50° W. to about N. 50° E. and from the horizon to an arc whose maximum altitude lay in the site of the red patch in the north. At 10:45 P.M. there was still a glow in the north sky, apparent to an altitude of over 5°.

The angles here given were estimated, as I unfortunately had no instruments available at the time.

C. W. TOMLINSON

UNIVERSITY OF ILLINOIS

On the evening of Thursday, March 7, a remarkable auroral display was visible here. Some observers report a faint red glow in the eastern sky as early as seven o'clock, and it would appear from the testimony of several observers that the phenomena increased in brilliancy until about 9:45, at which time it

was particularly striking. From the extreme northwest a broad band of deep red, like a cloud reflection of a conflagration, spread upward to a point in the constellation Cancer, just south of the zenith, where it terminated within a horseshoe-shaped mass of white having the convex side toward the north. A similar but less brilliant red cloud extended from this point toward the east. Culminating at the same point within the horseshoe were greenish white streamers extending in all directions to the horizon. At this time also there was another red patch covering somewhat more than the area of the Great Bear in the northeast. Athwart this ran the zenith streamers from the north horizon.

At 10:45 the overhead display was fading and a broad red patch in the northwest covered Cassiopeia. This rapidly divided into two parts, drifting west and south.

By 10:30 the effect had practically disappeared except for a greenish glow toward the north.

Although the deep red color was massed in the streamers and patches mentioned, the entire sky was tinged with red, shading gradually outward from these dense masses.

C. M. Smith

Purdue University,
Lafayette, Indiana

SCIENTIFIC BOOKS

Catalogue of the Hemiptera of America North of Mexico, excepting the Alphididæ, Coccidæ and Aleurodidæ. By Edward P. Van Duzee. University of California Press 1917. Pp. i–xiv, 1–902.

The completion of this great paper marks another distinct advance in the study of North American insects. The large order Hemiptera has had comparatively few devotees, though select, as the names of Fieber, Stål, Reuter, Bergrot, Horváth, and Uhler will indicate, and until recently its study has been somewhat backward as regards quantity if not quality. During the last few years, however, a great many of the younger students of entomology have elected to become hemipterists, and in consequence there has been a sudden increase in scattered contributions with a general rise of interest in the order. The present is, therefore, a peculiarly fortunate time for the appearance of a full bibliographical catalogue which brings together in orderly and properly conservative form a report of what has so far been accomplished and furnishes an adequate basis for further advance. Hemipterists, if few in number, have been unusually prolific, as is attested by the more than 900 large pages of the volume under consideration.

Careful examination of the work reveals a well-planned and faithfully executed enterprise. The author exhibits a masterly grasp of his subject, as a whole and in detail, and his production merits the warmest praise in every respect. In the introduction Mr. Van Duzee gives a clear and convincing statement of the nomenclatorial principles which have guided him. These are his well known and by no means ultra-conservative views, grounded firmly on the International Code, eminently logical in theory and successful in practise. For the first time the principle of priority is applied and fully worked out in connection with the names of all taxonomic groups, with such happy results that to me the general adoption of this plan seems sure. Original spellings are retained, but the author expressly disclaims any intention of restraining those who refuse to assist in perpetuating philological and grammatical errors. In addition to these general matters, a number of special points deserve particular attention.

In recording the distribution of the species, the author has done well to abandon the method of his recent check list, simply giving under each species a list of the states in which it is known to occur. As he remarks in the introduction, "our knowledge of the distribution of our species is still too fragmentary to allow the satisfactory naming of a habitat,'"—a procedure too frequent in hemipterological writings. In this way the student is forcibly reminded of the extensive lacunæ existing in this branch of the study, and he can go about the business of filling them with some confidence. The scarcity of

Canadian records is particularly striking—and regrettable, in view of the apparent significance of holarctic migrations in the past. Omissions seem very few, considering the magnitude of the work. I note the absence of certain published records, *e. g.*, *Sciocoris microphthalmus* (Palæarctic), *Zelus socius* (Me., Mass.), and a scarcity of Maine records before page 151.

It is an especial pleasure to report the extreme care which the author has evidently taken to avoid minor errors, clerical and typographical. This class of mistakes, though hardly susceptible of complete extermination, has been reduced to an attenuated minimum, contrasting most favorably with much past and contemporary work. *Dictyonota tricornis americana* page 815, occurs in Maine, not "Mo." *Lethiini* (properly *Lethæini*) on page 196, and *Systelloderus* (properly *Systelloderes*) on page 225, are lonesome examples of misspelling, I believe.

The typography calls for a special word of praise. The choice of types and the arrangement of the matter on the page are unexceptionable and aid the eye greatly in making quick reference, quite in contrast to the arrangement adopted in the author's check list.

The species are numbered in agreement with the check list, additions being indicated by fractions, a detail which will serve the convenience of collectors, though it conveys a wrong impression regarding the number of species comprised in the various groups. The author gives 3,198 as the number of North American species now included in the order (three families excepted), a net gain of 253 since the check list appeared in 1916. Of this total the Heteroptera number 1,629, the Homoptera 1,569.

A publication of this type must appeal to a far wider circle than that of the comparatively few specialists to whom it is of most immediate and intense interest, since every biologist has frequent occasion to ascertain the present taxonomic status or the known distribution of some form with which he may be concerned. Entomologists will at once perceive the value of Mr. Van Duzee's work—to others it may be recommended unreservedly as authoritative and reliable in the highest degree.

H. M. PARSHLEY

SMITH COLLEGE

SPECIAL ARTICLES

REPORTING MOISTURE RESULTS[1]

THE following quotations[2] is explantory of the soil physicists' use of the term percentage in connection with weight determinations of moisture.

> Suppose a certain soil in field condition weighs 100 pounds to the cubic foot and carries 10 pounds of water. Obviously it would contain 10 per cent. of water by the wet method of calculation, or 11.1 per cent. of water using the absolutely dry soil as the basis. . . . In ordinary calculations of water, . . . the percentage by dry weight is generally used because of its simplicity and the facility of expression that it affords.

Analyses are reported by chemists both on the wet and dry bases. The form in which an analysis is usually stated is as follows:

TABLE I

Soil Analysis

	Wet Basis, Per Cent.	Dry Basis, Per Cent.
Moisture	20.0	
Volatile matter	20.0	25.0
Ash other than silica.	10.0	12.5
Silica (SiO_2)	50.0	62.5
Total	100.0	100.0

It is noted that the per cent. of moisture contained is not included in the dry basis analysis.

To ascertain if the practise of stating the amount of water, present for every 100 parts of dry material, as "per cent. of moisture on the dry basis" leads to false interpretations the following data was given to several chemists and to three soil physicists:

1 Contribution from Research Chemistry and Bacteriology Laboratories of department of horticulture, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

2 "Soils, their Properties and Management," 1915 edition, by Lyon, Fippin and Buckman.

TABLE II

Soil Analysis Calculated to Dry Basis

	Per Cent.
Volatile matter	25.0
Ash other than silica	12.5
Moisture in sample	20.0

Wanted the percentage composition of the soil as submitted to the analyst in percentages of moisture, silica, ash other than silica and volatile matter.

than the chemist, *who made them*, found in the analyses he made. Soil physicists are apparently not the only class who are denoting the moisture present in certain materials as "per cent. on the dry basis." Different individuals and laboratories have been observed when making moisture determinations to report, for example, 33.3 per cent. moisture when the material under analysis contained 25 gm. of moisture in every 100 gms. of material.

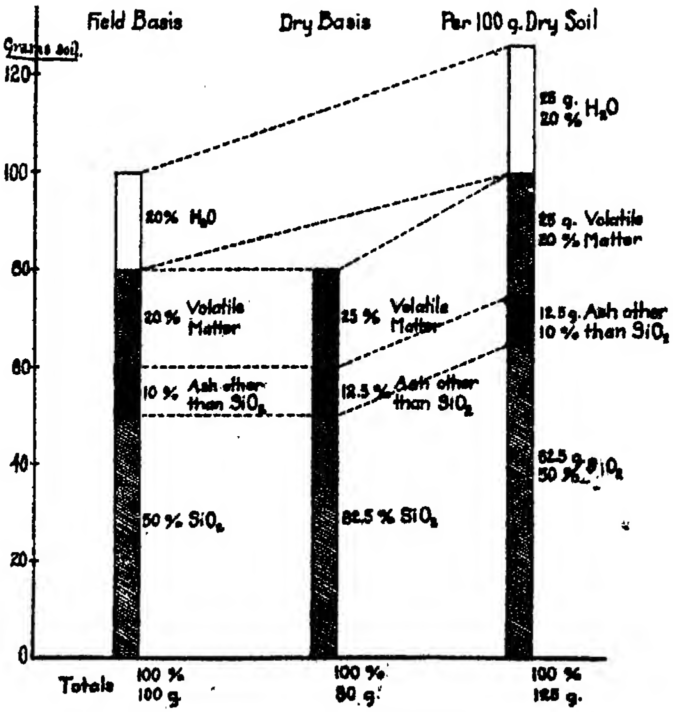


FIG. 1.

TABLE III

Interpretation of Soil Analysis

	Soil Physicists. Per Cent.	Chemists. Per Cent.
Moisture	16.0	20.0
Silica	52.5	50.0
Ash other than silica.	10.5	10.0
Volatile matter	21.0	20.0
Total	100.0	100.0

The above table is evidence that the practise of stating moisture as "per cent. on the dry basis" has caused the soil physicist to regard analyses to mean different percentages

Here the phrase, "per cent. of moisture on the dry basis" was not included, for they consider that analyses should be taken as on the dry basis, unless it is specified otherwise. The interpretation to be given incomplete analyses must be based on a knowledge of the reporter's method of calculating moisture. This often has to be learned through correspondence.

It is said that "usage dictates." In this connection there are different uses made of the word per cent. The analyst is not the one to

determine the basis on which soil physicists and certain others must compare soils. It is contended, however, that the soil physicist should not be allowed to express ratios as percentages unless the substances so reported are actually contained in the material in the condition reported upon. The analyst does not include the moisture in a dry basis analysis for the object of the dry basis analysis is to eliminate the moisture so that the constituents of the material may be readily compared in amounts with those in other materials.

Speaking of the per cent. of moisture in moist soil the following quotation is made:

> For example, 100 grams of wet soil containing 5 per cent. of water would consist of 5 grams of water and 95 grams of soil, a ratio of 1 to 19. If the soil contained instead 25 per cent. of water, the ratio would be 1–3 instead of 1–3.8 as the percentages would naturally lead one to expect.

In speaking of the particular objection referred to above the same authors write:

> In using a percentage of moisture based on the dry soil instead of on the wet, the first of the above objections is eliminated. Consequently this method of expression is perfectly legitimate as long as soils having about the same specific gravity are compared.

The above is taken to signify that the soil physicist has decided that the weight of water present with each 100 parts of dry soil gives him a better basis of comparing soils than he would have if he stated the same result in terms of percentage composition: example, that 100 grams of dry soil will take up 50 grams of water is a better basis of comparison for the soil physicist that the soil contains 33.3 per cent. of moisture when saturated.

If those, including in addition to soil physicists, chemists, botanists and general agriculturalists, who have been reporting moisture as "percentage on the dry basis" would substitute something for the WORDS per cent. or percentage in this connection all would interpret moisture results as they were intended to be interpreted.

The following phrases which serve the case equally well are suggested:

1. Ratio of water to 100 parts of dry soil.
2. Parts of water with 100 parts of dry soil, under conditions specified.
3. Moisture with 100 parts of dry soil.
4. Grams moisture per 100 grams of dry soil.

H. A. NOYES

PURDUE UNIVERSITY

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE annual meeting of the Federation or American Societies for Experimental Biology, which includes The American Physiological Society, The American Society of Biological Chemists, The American Society for Pharmacology and Experimental Therapeutics and The American Society for Experimental Pathology, held its annual meeting at the University of Minnesota, December 27 and 28, and at The Mayo Foundation, Rochester, Minnesota, December 29. 1917. The meetings were very well attended and the scientific interest was unusually strong. Every one voted the sessions an unqualified success.

The meeting opened with a joint session of the societies on Thursday morning and closed with similar joint sessions at Rochester, Saturday morning and afternoon. Friday afternoon was given to joint demonstrations and the Saturday morning session opened with surgical and scientific laboratory demonstrations at Rochester. The physiologists held three special sessions, the biochemists and pharmacologists each two special sessions, and the pathologists one special session. Some 265 guests were present at the joint dinner provided for the federation, the anatomists and the zoologists given at the Hotel Radisson, Thursday evening, December 27. The local committee provided very convenient arrangements for the meetings in Millard Hall, University of Minnesota Medical School. The membership of the society is indebted to the local committee for the very pleasant smoker and buffet luncheon Friday evening.

A special train carried the visitors to the last day's session at Rochester. A very pleasant interval was the noon-day luncheon by the hospitality of Dr. and Mrs. William J. Mayo at their home in Rochester. The session closed with a dinner under the auspices of the Mayo Foundation staff at the Hotel Zumbro and a social and smoker which followed at the Mayo Clinic assembly hall.

The officers and members of the American Federation feel under special obligation to the local committees at Minneapolis and Rochester for the

carefully executed arrangements for the comfort and success of the entire series of meetings.

Chas. W. Greene,
General Secretary

THE THIRTEENTH ANNUAL MEETING OF THE AMERICAN PHYSIOLOGICAL SOCIETY

The thirtieth annual meeting of the American Physiological Society was held with the Federation of American Societies for Experimental Biology, at the University of Minnesota, December 27 and 28, and at The Mayo Foundation, December 29, 1917. The program of the physiologists was crowded from beginning to end, in fact this is the only criticism to be offered upon the success of the meeting. The time allotted did not allow adequate time for discussion. The scientific papers were of widely distributed interest, but special mention may be made of the series of investigations on the subject of surgical shock, and papers on the physiological, clinical and chemical studies and the identification of the active iodine-containing principle of the thyroid. Dr. Kendall reported the synthetic production of this substance.

The attendance of the meeting was good though not large, about twenty per cent. of the total membership. However the attendance was very representative of both the varied scientific interests of the society and of the extremes of territory. Some thirteen were present from the Atlantic coast, four from the Pacific slope. Canadian representatives were present from Toronto to Manitoba. On the whole the meeting was voted one of the most successful ever held by the society.

The following new members were elected: Walter C. Alvarez, M.D., instructor in research medicine, University of California Medical School, Hooper Foundation; A. M. Bleile, M.D., professor of physiology, Ohio State University; Montrose T. Burrows, associate professor of physiology, Washington University Medical School; E. B. Forbes, B.S., Ph.D., chief in nutrition, Ohio Experiment Station; Maurice H. Givens, Ph.D., fellow and assistant in physiological chemistry, Yale University; Alfred E. Livingston, associate in physiology, University of Illinois, College of Medicine; Fred T. Rogers, Ph.D., instructor in physiology, University of Chicago; R. W. Scott, A.B., M.D., associate in physiology, Western Reserve University Medical College; James R. Slonaker, B.S., Ph.D., assistant professor of physiology, Leland Stanford Jr. University; Frank W. Weymouth, A.B., Ph.D., assistant professor of physiology, Leland Stanford Jr. University.

The officers elected for the ensuing year were Frederic S. Lee, Columbia University, President; Charles W. Greene, University of Missouri, Secretary; Joseph Erlanger, Washington University, Treasurer, and J. J. R. Macleod, Western Reserve University, Councilor for the 1918–1921 term.

The program presented is given below:

SCIENTIFIC PROGRAM AT MINNEAPOLIS

Hunger, appetite and gastric juice secretion in man in prolonged fasting (15 days): A. J. Carlson, University of Chicago.

On so-called "fatigue-toxin": Frederic S. Lee and B. Aronowitch (by invitation), Columbia University.

Some phases of industrial fatigue: Frederic S. Lee (for the Committee on Industrial Fatigue).

The quantitative measure of general fatigue: A. H. Ryan, Tufts Medical College.

Strength tests in industry: E. G. Martin, Stanford University.

Nutritive factors in some animal tissues: Lafayette B. Mendel and Thomas B. Osborne, Yale University and Connecticut Experiment Station.

Experimental mammalian polyneuritis: Carl Voegtlin and G. G. Lake (by invitation), Hygienic Laboratory, Washington, D. C.

Further observation on the production of lactic acid following alkaline injections: J. J. R. Macleod, Western Reserve University.

The isolation and identification of the thyroid hormone: E. C. Kendall, The Mayo Foundation.

Some problems of nutrition of the army, the work of the food division of the Surgeon General's Office: John R. Murlin, U. S. Sanitary Corps, Washington, D. C.

The influence of music on cardiograms and blood pressure: Ida H. Hyde, University of Kansas.

A simple method for the resuscitation of the human heart: A. D. Hirschfelder, University of Minnesota.

Regulation of venous blood pressure: D. R. Hooker, Johns Hopkins Medical School.

Blood pressure in sharks and the shock problem: E. P. Lyon, University of Minnesota.

Observations in shock: C. C. Guthrie, University of Pittsburgh.

Shock and its control. (Paper from France presented by Dr. Lee.) W. B. Cannon.

Observations on the volume flow of blood of the submaxillary gland: Robert Gesell, Washington University.

The rôle of the central nervous system in shock: F. H. Pike, Columbia University.

Some reactions in the development of shock by diverse methods: J. ERLANGER, ROBT. GESELL, H. S. GASSER and B. L. ELLIOTT (by invitation), Washington University.

A method for the determination of blood volume: WALTER J. MEEK and HERBERT S. GASSER, University of Wisconsin.

The blood volume changes in shock and the modification of these by Acacia: H. S. GASSER, W. J. MEEK and J. ERLANGER.

A study in Acacia in view of its use in perfusion solutions: WALTER J. MEEK and HERBERT S. GASSER.

Diet experiments bearing on carbohydrate luxus consumption and wasteful eating: ADDISON GULICK, University of Missouri.

The physiological action of the thyroid hormone: E. C. KENDALL, The Mayo Foundation.

Effects of salts on the metabolism of nerves: L. K. RIGGS (by invitation), University of Chicago.

Test of methods of control of the clothes louse: WM. MOORE, University of Minnesota.

The tension of the respiratory gases in the afferent and the efferent blood of the lungs: ROY G. PEARCE, Lakeside Hospital, Cleveland.

Graphic records of reflexes and clonus: R. E. MORRIS (by invitation), and L. G. ROWNTREE, University of Minnesota.

The cerebral center of mastication: F. R. MILLER, Western Reserve University.

Relation of lesions of the optic thalamus to nystagmus, body temperature and spinal reflexes in the pigeon: FRED R. ROGERS (by invitation), University of Chicago.

Comparison of the rhythm of the respiratory center and trapped wave in Cassiopea: J. F. McCLENDON, University of Minnesota.

Some points in the nervous regulation of respiration in the cat: C. C. GAULT (by invitation), University of Minnesota.

The effect of alteration of blood pressure on the blood of the rabbit: F. H. SCOTT, University of Minnesota.

Adrenalin vasodilator mechanisms in the cat at different ages: FRANK A. HARTMAN, University of Toronto.

Vasodilator nerves of the skin: H. RICHARDSON and O. WYATT (by invitation), University of Minnesota.

A note on the mechanism of heart muscle contraction: MONTROSE T. BURROWS (by invitation), Washington University.

Evidence of toxic action of the ovaries of the gar: CHAS. W. GREENE, ERWIN E. NELSON (by invitation), and EDGAR D. BASKETT, University of Missouri.

Some electrical phenomena of the submaxillary gland: ROBERT GESELL, Washington University.

Vagotonic and sympathetic-atonic effects on gastric motility: T. L. PATTERSON (by invitation), Queen's University.

A new factor in the control of the pylorus: ARNO B. LUCKHART, University of Chicago.

The rôle of catalase in shock: W. E. BURGE, University of Illinois.

Studies on gastric secretion and urine ammonia: A. C. IVY (by invitation), University of Chicago.

The effects of alkalies on gastric secretion: CHAS. E. KING, University of North Dakota.

The influence of water on gastric secretion: G. F. SUTHERLAND (by invitation), University of Chicago.

The cause of the chill and febrile reaction following transfusion of citrated blood: CECIL K. DRINKER and HAROLD H. BRITTINGHAM (by invitation), Harvard University.

Further evidence of the mechanism of the production of the sounds of Korotkoff: A. M. BLEILE (by invitation), and CLYDE BROOKS, University of Ohio.

Duration of the systole and diastole of the human heart: W. P. LOMBARD, University of Michigan.

JOINT DEMONSTRATIONS AT MINNEAPOLIS

A new diastolic criterion in oscillatory blood pressure registration in the human: BERNARD FANTUS (by invitation), Chicago.

The mechanical factors influencing the cerebrospinal fluid: H. C. BECHT, Northwestern University.

An automatic and bloodless method of recording the volume flow of blood: ROBERT GESELL.

Stimulation under increased intra-cranial pressure: A. S. LOEVENHART and MESSRS. MARTIN and MALONE (by invitation), University of Wisconsin.

On a uniformly satisfactory method of collecting urine separately from each ureter in acute experimental work on dogs: ARNO B. LUCKHARDT, University of Chicago.

Demonstration of the pre-anacrotic phenomenon and its relation to the arterial compression sounds of Korotkoff: JOSEPH ERLANGER, Washington University.

An apparatus for the determination of the tension of the alveolar gases in arterial and venous blood: ROY G. PEARCE and W. W. YORK (by invitation), Western Reserve Medical College.

Colorimeter and tubes for P_h of sea water: J. F. McClendon, University of Minnesota.

Electrometric titration of blood plasma: J. F. McClendon.

Some uses of wire in the laboratory: A. D. Hirschfelder, University of Minnesota.

Simple valves for respiration experiments: A. D. Hirschfelder and E. D. Brown.

A simple method of making stalagmometers: A. D. Hirschfelder.

An experiment for affording training in intravenous and intraspinal injections: A. D. Hirschfelder and E. D. Brown.

Demonstration of a new form of colorimeter: Joseph C. Bock and S. R. Benedict, Cornell Medical College.

Method of recording reflexes: R. E. Morris and C. E. Nixon, University of Minnesota. (By invitation.)

A simple pneumograph: E. D. Brown, University of Minnesota.

JOINT PROGRAM AT ROCHESTER

8:00–10:00. Surgical Clinics, St. Mary's Hospital.

8:00–10:30. Experimental and Clinical Laboratory Demonstrations, Mayo Clinic Building.

10:30–12:30. Joint Scientific Session Federated Societies, Assembly Room, Mayo Clinic Building.

Comparative measurements of new-born babies: Rood Taylor (by invitation), The Mayo Foundation.

Blood-cholesterol in malignancy and the effect of radium on blood-cholesterol: G. M. Luden (by invitation), The Mayo Foundation.

The normoblast crisis; its place, significance and duration in blood regeneration: Cecil K. Drinker, Katherine R. Drinker and Henry A. Kurtzman (by invitation), Harvard Medical School.

The rôle of afferent impulses in the control of respiratory movements: H. C. Combs (by invitation), and F. H. Pike, Columbia University.

Parallel determinations of amylase and dextrose-glycogen of the blood, liver and kidney after feeding: E. Eugene Brown (by invitation), and Chas. W. Greene, University of Missouri.

Note on psychic secretion from the sight and smell of food in man: Arno B. Luckhardt, University of Chicago.

Brain changes associated with pernicious anemia: H. W. Woltmann (by invitation), The Mayo Foundation.

Effects of cytolysins on the rabbit in relation to inheritance: M. F. Guyer, University of Wisconsin.

Bio-pathological standardization: W. C. MacCarty (by invitation), The Mayo Foundation.

A study of the comparative anatomy of the biliary tract and the Sphincter of Oddi with special reference to animals without a gallbladder: F. C. Mann, The Mayo Foundation.

Some further notes on the detoxification of potassium chloride in the guinea-pig: Samuel Amberg and P. E. Helmholtz (by invitation), Children's Memorial Hospital, Chicago.

Physiological function of the thyroid: H. S. Plummer (by invitation), The Mayo Foundation.

Development of certain types of malignant tumors of the thyroid: Louis B. Wilson (by invitation), The Mayo Foundation.

Blood regeneration after simple anemia. Curve of regeneration influenced by dietary factors: C. W. Hooper and G. H. Whipple (by invitation), Hooper Institute.

Blood regeneration after simple anemia. Curve of regeneration influenced by starvation, sugar, amino acids and other factors: G. H. Whipple and C. W. Hooper (by invitation), The Hooper Institute.

Fat embolism: W. W. Bissell (by invitation), The Mayo Foundation.

Lipemia (20 minutes): W. R. Bloor, Harvard University Medical School.

The action of light in injuring the eye: W. E. Burge, University of Illinois.

Changes in reflex thresholds following intestinal manipulation: Eugene L. Porter, University of Pennsylvania.

Lipase and fat variations in the blood as a result of muscular work: Dudley A. Robnett (by invitation), and Chas. W. Greene, University of Missouri.

Simultaneous measurements of the lipase and fat of the blood, liver and kidney during digestion and absorption: George G. Harvey (by invitation), and Chas. W. Greene.

Note in regard to the amount of sugar normally in blood of cats: E. L. Scott, Columbia University.

On the comparative absorption power for drugs of the bladder and urethra (male): David I. Macht, Johns Hopkins Medical School.

On the relation of the chemical structure of opium alkaloids to their action on smooth muscle structures: David I. Macht, Johns Hopkins.

Chas. W. Greene,
Secretary

SCIENCE

FRIDAY, MARCH 29, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE CONTRIBUTIONS OF ZOOLOGY TO HUMAN WELFARE[1]

To indicate the contributions of zoology to human welfare as related to or dependent upon the aquatic resources is the task which has been assigned to me, but because of time limitations the subject must necessarily be covered in a superficial way. The consideration of this phase of the general topic, whose application may for present purposes be restricted to the United States, is based on the assumption that the condition of aquatic resources affects our national prosperity, and that full and accurate knowledge of those resources is a prerequisite to their proper utilization.

The theme is fertile and inviting, and there should exist no difficulty in establishing a case for zoological research as a noteworthy contributor to our welfare. My task is lightened by the readiness with which nearly every one will recall important rôles that zoology has played in the modern history of the fishing industry.

It is doing no violence to truth or justice to claim that the beginnings of sane and beneficent fishery administration in the United States date from the time when a man, already eminent in science, with many years' experience in zoological work, was chosen by the President of the United States as the proper person "to prosecute investigations on the subject of the diminution of the valuable fishes with a view of ascertaining whether any and what diminution in

[1] Read before Section F (Zoology) of the American Association for the Advancement of Science at a symposium upon "The Contributions of Zoology to Human Welfare," Pittsburgh, Pa., December 31, 1917.

the number of the food-fishes of the coasts and the lakes of the United States has taken place; and, if so, to what causes the same is due; and also whether any and what protective, prohibitory or precautionary measures should be adopted in the premises."

Since that year (1871) when Baird began those masterly and far-sighted inquiries, zoology has been the constant forerunner or associate of fishery progress; and the conservation of the resources of our lakes, rivers and coastal waters became an established policy and an accomplished fact many years before the term conservation came into general use as applied to any other resources.

At the outset of that pioneer movement, it was recognized that the only rational basis for the administration of the fisheries was a complete knowledge of aquatic creatures to be acquired by intimate investigation. The early researches, which have served as models for subsequent work, were expected to yield practical results but were conducted without any sacrifice of the cherished principles of science. In fact, Baird had the courage, which some persons might have regarded as temerity, to insist in his communications to Congress and the general public that in the elucidation of the economic problems which Congress had imposed it would be of doubtful value to study only the major forms which supported fisheries and that "useful conclusions must needs rest upon a broad foundation of investigations purely scientific in character."

Baird's reputation and official position and the attitude with which he approached his tasks enabled him to draw to his aid a large body of men trained in the methods of zoological research; and the great success of his early investigations, as of the later work that has been their continuation or outgrowth, was largely, in many instances entirely, dependent on the services of zoologists, most of whom were university men. I need only mention the names of Birge, Brooks, Bumpus, Dean, Evermann, Forbes, Gilbert, Goode, Grave, F. H. Herrick, Jordan, Kellogg, Lefevre, Linton, Mead, Parker, Rathbun, Reighard, Ryder and Ward to recall to you zoological work that has made an impress on the public welfare and entitles them, and others whose names will occur to you, to the thanks of a republic which has become more and more grateful as the knowledge of their work has spread.

It was the work of Baird and his associates in zoology that chiefly induced Huxley to assert his belief that no nation at that time had comprehended the question of dealing with the fisheries in so thorough, excellent and scientific spirit as the United States.

Brief reference may now be made to a few special cases out of the many that might be cited in which zoology has rendered noteworthy service. Passing over the high degree of perfection that has been attained in various branches of governmental and private fish culture, largely as a result of embryological and physiological studies, attention may be invited to the American oyster, which because of its prominence as our principal water product has deservedly received consideration at the hands of some of the leading zoologists. I need only recall the work of Brooks and Ryder who, with others, brought their highly developed scientific minds to bear on the practical problems of the oyster industry and, through their studies of the biology of the oyster and from experimental work in oyster rearing, rendered conspicuous and enduring aid.

With the oyster, as with other water creatures, the teachings of zoology have been at complete variance with the confirmed practises and deep-seated prejudices of certain states. The welfare of their

oyster industry was for a long period neglected; and the delivery of these states from the thraldom of obsolete, inefficient and wasteful methods has depended on their eventual willingness to accept zoological facts as the basis for administration.

Another of our great aquatic resources that has suffered from the failure or refusal of the states to be guided by the teachings of zoology is the lobster. If the states had given heed to the elementary needs of the lobster as proclaimed by Herrick, instead of shaping their course so as to conform with the interests of those who for years have been profiteering at public expense, they could have made the lobster a staple, moderate-priced food for all time, whereas it has become such a rare and expensive article that the food administration might very properly place an embargo on its use as a wholly unjustifiable extravagance. One alleviating circumstance is that, through the adoption of a system of artificial rearing devised by the zoologist Mead, the lobster supply in the waters of Rhode Island has been maintained better than in any other state.

One of the most noteworthy cases of the application of zoology to the public good is the prompt use that the government made of Lefevre and Curtis's investigations of the habits of the glochidia of the pearly mussels. The practical problem here presented was the maintenance of an industry that supports many thousands of people and directly affects every man, woman and child in the United States. It should be remembered to the everlasting credit of our national law-making body that it was willing on purely zoological claims, which were the only ones that could be put forth at the time, to establish an expensive station and adequate personnel for applying the results of zoological researches and experiments. The influence of that laboratory on the policy of the interested states has been great; the immediate results of practical value have been conspicuous; and the way has been made plain by which this great national resource, which far surpasses in value and volume that of all other countries combined, may be preserved through proper utilization.

Reference should be made to the extraordinary advance in knowledge of the age and growth of fishes that has come from recent studies of their scales and bones, and to the opportunity that is thereby afforded for the first time to substitute facts for guesswork in formulating protective fishery laws bearing on the size and age of food and game fishes.

A year or two ago there arose a situation in one of the largest seaboard cities where ill-advised administrative action threatened to exclude from the market one of the most abundant and wholesome marine fishes, with consequent disturbance of long-established trade and serious loss to the fishermen even of remote regions. A real disaster impended because a market inspector saw certain parasites and misconstrued their significance. The evil was averted by the ability of the government to recommend to the city authorities a zoologist with a most convincing mass of zoological evidence, with the result that the embargo was promptly lifted and in all probability will never again be placed in that community for such a reason.

The great contributions that zoology has made to all branches of fishery work have not exhausted the field. Dependence must continue to be placed on zoological research for the elucidation of the greater problems that are looming. A hopeful sign of the times is that the public now appears to be more willing than ever before to defer to and depend on the recommendations of zoology in the handling of fishery questions.

H. M. Smith

Bureau of Fisheries,
Washington, D. C.

THE VALUE OF ZOOLOGY TO HUMANITY

The task assigned me is to present to you as adequately as may be possible in the brief time allotted this topic, the significance of studies on animal parasites for the progress of the human race.

Since the earliest times of unwritten history human records bear evidence to the bitter warfare waged by men of all races against the large carnivores that threatened their existence and played havoc with the useful animals they had brought under control. As time went on and his purview gained in breadth man turned his attention to noxious types such as the snakes, and to smaller forms like the rats that are real though less conspicuous foes. And, finally, in very recent years, he has learned to understand that minute organisms like the blood-sucking insects are not only sources of discomfort but also play an essential part in the transmission of many of the microscopic organisms that produce disease. He knows that these organisms both plague and destroy the domesticated animals, that they greatly reduce his own efficiency and, threatening his very existence, drive him away from rich and fertile territory or in a single epidemic wipe out families, villages, or even whole nations. In short, animals nowhere affect man more extensively and more seriously than in those relations in which they appear as the agents in producing or transmitting disease, and it is of fundamental importance for the progress, prosperity and even existence of the human race that those relations should be investigated, determined with precision, and brought under control.

This in a broad general way is the problem of parasitology, and it is important at the very outset to indicate that it is not set off from other studies on animal life by any hard and fast limits. The structure of parasitic animals can be interpreted rightly only by the results of knowledge gained concerning the anatomy of free-living forms; the development of parasitic species depends for its explanation on the results of studies on the development of animals generally; the habits of parasite and host are so intimately interlocked that the key to the life history of a parasite is found in the associations of the host. Now the recognition of this intimate and necessary connection between zoology in the narrower sense and parasitology is of relatively recent date and has favored promptly and conspicuously the contributions of zoology to human welfare. Brief reference to the history of science may serve to make this point somewhat clearer than it appears in the general statement.

As a matter of fact parasitology is of the oldest phases of the study of animal life and its even yet faintly recognized relations to man. Diseases caused by animal parasites played evidently an important part in the economy of the nations of antiquity. The oldest medical works that have come down to us give intelligible records of the presence in man of such guests and in some cases recognizable descriptions of the parasites themselves. This study pursued under the direction of the priests and medical men was developed apart from other fields of zoology. As a result the knowledge thus gained reached more considerable proportions and was more widely disseminated at an early date than the general knowledge of animal structure or of animal function. To some extent the separateness of the two fields exists at the present date, to the disadvantage of scientific progress and human welfare.

The parasites known to the ancients were of course the larger, more conspicuous forms. And while some important facts were included, their knowledge was con-

fused with such a mass of fable and superstition that its value as a guide to a rational life was not large. Moreover these large forms are not the most dangerous parasites, *i. e.*, those of greatest significance for human existence; and hence in that period the contributions from the study of parasitology to human welfare were not conspicuous.

Something like a century ago students came to see, faintly and slowly at first, that animals affect man very directly because some of them are definite factors in the production or transmission of disease. One can hardly overestimate the importance of the contributions made by zoologists toward the solution of the problems presented in this field. At first the instances of animals as causes of disease appeared rare, and were recognized only among the higher parasites. In particular cases of this type a demonstration was achieved and the evidence became clear as scattered observations of individual workers were brought together by some master mind and formed into a consistent and sufficient explanation of the malady. A splendid illustration is furnished by the epoch-making investigations of Leuckart and others on trichina. Owen had found in a dissecting room in London a worm encysted in human muscle and had rightly interpreted it as a nematode; another form was discovered by Leidy in Philadelphia in pig muscle and recognized as identical with that reported by Owen; and, finally, adult intestinal parasites were obtained from cases in Germany which had been previously diagnosed as typhoid, and all these were shown to represent only different stages in the life history of a single parasite, the trichina. The natural result of these studies was the formulation of a rational prophylaxis which, when adopted, eliminates trichinosis absolutely from the list of human ailments.

These early and significant discoveries were accompanied by others of lesser importance on various other worms but remained after all relatively isolated for a long time. The reason is not hard to find. The rapid and brilliant rise of bacteriology to a position of prominence and its overwhelming demonstrations that bacteria were the causes of many diseases led investigators to seek insistently for them in all maladies of an apparently infectious type. Failure to find them was explained on the basis of defective technic and the possible existence of other disease-producing organisms was generally overlooked.

To be sure, malaria had been traced to a protozoon, but the instance remained isolated for many years until a combination of causes directed scientific attention to the importance of more exact studies on that and allied organisms, and these in turn opened up a new field, that of protozoal diseases. In the investigation of this field, zoological students have performed the chief and almost the only extensive work, and the results of their researches have been of tremendous significance to human progress.

In his "Malaria Studies of a Zoologist" Grassi laid the foundations for the complete elucidation of the life history of the *Plasmodium malariæ* and with that the basis for the adoption of communal and individual habits which have freed the world from the menace of a disease that has exacted a heavy toll from the great nations of all ages in human history. Coupled with this the demonstration of the rôle of the mosquito in transmitting yellow fever made possible for instance the building of the Panama Canal and the maintenance of a highly developed and cultured community on the Isthmus, whence less than half a century before the French workers had been driven out by pestilences so frightful

that no system of recruiting the workers could keep pace with the destruction of human life wrought among them by these diseases.

One should not pass without notice a group of protozoal and bacterial diseases transmitted by insects, such as sleeping sickness, bubonic plague and the various relapsing fevers, all of which owe their spread in nature exclusively to inoculation by bedbugs, ticks and biting flies. The significance of scientific discoveries which have led to formulation of measures for the control of such diseases may be estimated in correct propositions when one bears in mind that at a very recent date malaria has claimed in Italy alone 200,000 victims annually, sleeping sickness 500,000 in Africa and plague in India has often destroyed more than a million victims in the course of six months. Among those who have contributed prominently to the study of these organisms and to the solution of the problems of the diseases they produce must be named the zoologists Minchin and Fantham; of the work done on the insects that transmit such organisms appropriate mention is made by another speaker in this symposium.

Not less significant is the story of the hookworm and its ravages, which have extended over every part of the globe in tropical and subtropical regions and have justified the organization of a great philanthropic movement to combat them. The first great step in advance in the handling of this problem was taken when at the International Zoological Congress in Berne, Switzerland, the zoologist Looss demonstrated before a critical and unbelieving audience the intricate story of the migrations of this parasite and its mode of gaining entrance to the human host. Previous to that time, no effective measures for combating the disease had been worked out, save the procedure of abandoning infected territory which was in itself a clear confession of inability to cope with the difficulty. As a direct result of the definite knowledge concerning the life history of the parasite and its point of attack upon the human system, a code of procedure has been worked out so definitely that its introduction is in fact resulting in the elimination of the disease from human consideration. Foremost among those who have aided in achieving the brilliant results of the campaign against the hookworm stands the name of the zoologist Stiles.

When the city of Manila came under the control of the United States of America, one in four, if not one in three, of all the deaths occurring in its limits were due to the attack of the parasite of amebic dysentery. While it is premature to say that this problem has been solved, still, studies on the structure and life history of this and similar forms by the zoologist Schaudinn and others have contributed such information concerning the life history and the effects of this parasite as to indicate successful lines of defense against its attacks and to reduce greatly the toll of human life it exacts.

But these items do not indicate the extension of knowledge regarding such organisms. Even among the higher parasites studies of recent date have added to the list of forms that menace man several intestinal flukes, three blood flukes, a number of tapeworms and various roundworms, and there is no reason to think the list is complete. Each form demands an individual study of its structure, life history and habits before definite measures can be formulated for protection against its attacks. To recount all that has been done in the many cases would transcend the possible limits of this paper. A very large part of the significant information regarding these forms has been furnished by zoologists. When, however, protozoan parasites are taken into consid-

eration the field is vastly extended. Both in numbers and variety and probably also in virulence of attack they surpass the metazoan parasites. The volume of the literature dealing with such organisms has increased with great rapidity and new organisms as well as new problems are being discovered every day. When one adds to all this the important problems that concern parasites affecting domestic animals and thus the material welfare of the human race, the extent of the field of work on animal parasites can be to some extent appreciated. The mere listing of the names of those who have worked in this field fills pages in every annual bibliography of zoology.

Such examples as have been cited could be multiplied many fold. Some of the parasites are acknowledged to be serious foes of human progress and if in other cases the effects are less conspicuous because the organisms are confined within narrow geographical limits, still the significance of their control is no less important to the human race. Furthermore, with the development of commerce and the increasing movement of individuals from place to place, disease has lost its earlier local limitation and has become an international menace. To all students of social evolution disease looms high as a controlling factor in human affairs. History furnishes many records of epidemics that have depopulated great areas, routed victorious armies, and reduced virile and fruitful civilizations to an inefficient and sordid level. Throughout the expanse of the tropics, where nature rewards the efforts of the cultivator of the ground in a degree beyond all comparison with the results obtained in temperate climates, human social organization has generally remained on a low plane, or if at any point it took a brief spurt, the end of the advance came quickly and the nation sank to the common level again.

Man's failure thus far to achieve the conquest of the tropics may be traced distinctly to the ravages of tropical diseases unrestrained by natural limitations that are found in other climatic environments. Now these diseases are primarily those produced by animal parasites and in the control of such diseases lies consequently the possibility of utilizing the natural resources of the globe at the point of their greatest richness. What greater service could be rendered to humanity than the continued maintenance of highly organized social communities in the richest regions on the surface of the earth? The result already achieved in the Panama Canal zone and at many other individual points in the tropics can be duplicated generally. When this is done the possibilities of human existence will have been enormously enriched. Certainly the demonstration of such a possibility which has already been given in work quoted above should rank as the greatest achievement of zoological studies and inferior only to the realization of that possibility when the conquest of the tropics is completed because of the mastery of its diseases.

Before closing the discussion, I should like to call your attention to another phase which is much less conspicuous than those which have been treated before, but which in my opinion has distinct importance. This is the stimulus given by parasitology to the scientific discussions of biology and consequently to the extension of knowledge and to the general advantage accruing therefrom. Important side lights have been thrown upon morphology by study of the processes of modification and degeneration which are so conspicuously exemplified by parasitic forms. The life history and relationship of these types show many features

unique in themselves which serve to illuminate general biological principles. One can not for a moment doubt that in some way or other the processes of existence have worked striking modifications in the parasitic forms when one compares them with their free-living relatives and scans the changes which take place in the individual development. Not even the most extreme conservative would wish to maintain that the parasite was an original product, or would hesitate to grant that it had become adapted to its present mode of life. Yet more extraordinary and far-reaching structural modifications could hardly be asked for or found than those which are evident in the parasitic organisms. Nor would it be easy to conceive more intricate or more precisely balanced relations than those which exist between some parasites and their hosts. The development, modifications and habits of the parasite have been coordinated with the conditions of existence in the host in strikingly precise fashion. Investigation has as yet only begun to work out the adjustments which have arisen independently and in great variety in different species and groups of parasitic species. The field is one that offers unusual opportunities at the present time to the investigator.

We do not know how far an intimate study of these problems may carry us towards the explanation of the process of evolution in free-living organisms. There is reason to think that the change has been more rapid as well as more radical among parasitic species. And if so, the study of this problem at this point may be expected to throw welcome light on the factors that lead to structural changes in living organisms. Any such study will certainly serve an important purpose in broadening the human mind and encouraging it to seek the solution of the problems of existence more vigorously than it has even done as yet.

The outlook for the future constitutes no less than the achievements of the past, a real contribution to the cause of human progress.

Henry B. Ward
University of Illinois

THE INDIGEN AND CULTIGEN

If an author were to prepare a flora or manual of cultivated plants in any country, he would come hard against the fact that he deals with two gentes or types of species.

One gens has recorded origin, with the typical form well recognized and probably represented by a "type specimen" in the herbarium of the person who "founded" the species. It in an indigen of known habitat.

The other gens is a domesticated group of which the origin may be unknown or indefinite, which has such characters as to separate it from known indigens, and which is probably not represented by any type specimen or exact description, having therefore no clear taxonomic beginning. I trust I may be pardoned for calling such species or group a cultigen.

A good example of the cultivated indigen is *Thuja occidentalis*. Although there are many horticultural forms, their relationship is understood, we are familiar with the species in the wild, and we have the whole case before us. The variations under domestication are indeed great, but we readily range them with what we call the species itself.

A good example of the cultigen is *Zea Mays*. We know neither its country nor its origin. It is widely variable. If a botanist had before him good material of all these variations, I do not know what one of them he would take as "the type." It is a composite gens, with no clear taxonomic center from which variations diverge.

Here we have two classes of facts, with no adequate way of expressing one of them in taxonomy.

If *Zea Mays* were an isolated case we could treat it as an exception. I have before me a list of one or two hundred comparable cases,

and yet I have made no careful search. Botanical literature is full of cultigens, improperly or incompletely coordinated into taxonomic treatment.

The prime deficiency is the fact that many of the good cultigens are unrecognized botanically. In the presumed manual of cultivated plants, how would the author treat the tuberous begonia? Would he enter descriptions of the several indigenous species from which the cultigenous group has come, and stop there? But what, then, would the horticulturist do? He would say that *Begonia Veitchii, B. rosæflora, B. Davisii, B. Pearcei, B. Clarkei* are not in cultivation so far as he knows, and he asks what he shall call the tuberous begonia. He would charge that the tuberous begonia is left out, and his statement would be correct. If he is a dealer, he naturally and properly wants a name in his catalogue comparable with *Begonia Rex* and *B. semperflorens*. Voss solves this problem by calling the cultivated group *B. tuberhybrida*.

Now the botanist will say that *Begonia tuberhybrida* has no "type," no clear description properly published, and therefore no recognized taxonomic standing. It is essentially as good a case, however (except traditionally), as *Zea Mays*, which some persons now consider to be a bigeneric hybrid.

If we accept the Linnean and other historic cultigens, why not accept modern groups of similar or comparable origins? Are the following "good species" in the strict sense? *Triticum vulgare* L., *Hordeum vulgare* L., *Secale cereale* L., *Helianthus annuus* L., *Saccharum officinarum* L., *Pyrus Malus* L., *Ipomœa Batatas* Poir., *Abutilon pleniflorum* N. E. Br., *Lonicera americana* Koch, *Lilium japonicum* Thunb. and *L. testaceum* Lindl., and any number more. We have similar cases in the domestic animals, as *Felis domestica, Gallus domesticus, Canis familiaris.*

What are we to do with cultivated blackberries, ixias, gladiolus, fuchsias, and many of the magnolias, deutzias, spireas, pandanus, roses? What are we to do with the cultivated canna: what is this plant? Are we merely to pass it by, undescribed because it is a complex? To describe the various species of canna is of no consequence to its identification. At present there is no name under which we can describe the common garden canna. The point is, are we to name and describe cultivated plants or are we not?

What are we to do with such things as *Saintpaulia kewensis, Tritonia crocosmæflora, Iris flavescens, Ligustrum coriaceum, Eryngium Oliverianum, Fuchsia speciosa, Heuchera brizoides, Primula Polyantha*?

The cultigens are with us, and the numbers will increase. No longer can we let them go by default. The plant-breeder will bring his new groups; will taxonomy expand itself to receive them, or must they always be outcasts?

Even when the parent indigen is known, many of these cultigens have their own entity and by every taxonomic right should be separately recognized. They often present characters new, or different from those of the fundamental species, or at least in different combination. When recognized as admissible gentes, in the company of living things, they are no longer involved in debates as to the taxonomic merits of their ancestors. Even if we were satisfied to say that the cultivated blackberries are *Rubus allegheniensis*, what are we to say when *R. allegheniensis* is itself split into a dozen segregates?

Supose, now, we are to agree that *Zea Mays* is a hybrid of *Euchlæna mexicana* and X: are we then to describe *E. mexicana* and X in our manuals, and to say that Indian corn is a hybrid between them, dropping the name *Zea Mays* entirely? This is exactly the type of treatment we are giving great numbers of cultigens that have well-marked characteristics of their own. Many of our common cultivated plants can not be put in our manuals, because we have no names to call them by. What are we to call the florist's chrysanthemum? To describe its supposed parents, *C. indicum* and *C. morifolium*, is of no consequence; these are unknown to the cultivator, and moreover they are not the florist's chrysanthemum.

It is said that to admit such forms into the society of recognized species would greatly

disturb systematic botanical procedure. The replies to this position are two: (1) We have already admitted very many of them, even if under protest in some cases; (2) is botanical procedure to be competent to accept the facts of nature? Whether we will or no, these cultivated things will be known by botanical names. What are we to do with *Phlox decussata?* It may be a set of hybrids between *P. paniculata* and *P. maculata,* but we can not order the plant from the nurseries under either of these names. Referring the name *P. decussata* to one or the other of the species may satisfy the demands of synonymy, but it does not dispose of the plant. It is a good name for the group: why not use it?

Naturally we must have a formal and recognized system of taxonomy and nomenclature. We should keep it pure. But may it not be extensible? The interminable discussions over trivialities of priority in nomenclature tend to seal up the subject as a closed book, or as an ancient box of precious ointments. May we not open the book or carefully lift the lid?

I have no program. To-day I am only asking questions. I would not interfere in any way with the orderly procedure that we have found to be good. I would disturb nothing: but may we add?

May we not admit the cultigen, under well-considered practise of conservative and trained botanists, defended with proper safeguards? I am not thinking of mere variations, even if well marked, but of important groups or clans of known characteristics under domestication. If so, the gens should have standing, which means that the name should bear record of its author. Its name should have recognized botanical form, for cultigens are still plants and of more or less coordinate rank with other gentes known as species. While falling under recognized botanical procedure, might it not represent a category or class of its own? In the manuals perhaps its name would be set in a different type; or could a designating symbol be used? Under the International Rules, the cross-mark (x) preceding the name is recommended to distinguish hybrids; this can not be applied to any extent because records of hybrid origins are few; it does not touch the great class of cultigens: yet there must be some good way of distinguishing categories.

We must assuredly try to avoid confusion, but we do not accomplish this by avoiding the facts. Horticulturists as well as botanists are entitled to protection and precision. May we not make names for certain cultigens?

These may be troublesome questions, but they force themselves on us. Is it not best to meet them squarely, and provide a way?

If we can not modify our practise in these regards, there is no use of making a manual of cultivated plants.

L. H. Bailey

SCIENTIFIC EVENTS

THE RESEARCH COMMITTEES OF THE BRITISH INSTITUTION OF MECHANICAL ENGINEERS

Some particulars of the work of the research committees formed under the direction of the Institution of Mechanical Engineers are given in the report of the council for 1918 and are quoted in the London *Times*.

The alloys research committee has been occupied with investigations on various light ternary alloys. These investigations have been conducted at the National Physical Laboratory with the assistance of the Department of Scientific and Industrial Research from whom the committee received a grant of £400, in addition to £800 paid directly to the laboratory for the provision of special plant. The council of the institution made a grant of £250 for the year. The committee's eleventh report, which would have contained the results of these investigations, has been temporarily withheld in the public interest.

The committee on steam nozzles, which received a grant of £100 from the council, has been so fully occupied with war work that it has been unable to construct apparatus and carry out tests; but complete detailed working drawings of the apparatus for measuring the impulse of steam jets have been prepared, and it is hoped that the apparatus may shortly be put in hand.

Dr. Stanton, with his special machine at the

National Physical Laboratory, has continued the series of tests for the committee on hardness tests, with special reference to the effects of variations of load and speed on rate of wear. A series of wear rings of varying widths has been made from material supplied by Sir Robert Hadfield, who has also undertaken their hardening. Another holder for these rings has been constructed of a form which will considerably facilitate regrinding. A series of specimens has been prepared and the tests are now in hand. The work was delayed for some months owing to some of the apparatus being required for war work. In addition to the grant of £100 made by the institution, a sum of £100 has been received from the Department of Scientific and Industrial Research, Sir Robert Hadfield has placed in the hands of the institution a sum of £200 to be awarded as a prize or prizes for the description of new and accurate methods of determining the hardness of metals, especially those of a high degree of hardness, but the council regret that as yet few such descriptions have been received.

The work of the committee on wire ropes, to which a grant of £450 was made by the council, has been much delayed by war work and the prolonged illness of the chairman. Nevertheless a design for a testing machine has been approved in principle for giving a somewhat wider range of tests than was originally contemplated, in the direction of providing for more bends both simple and reverse, and also for bends in planes at right angles. The choice of a site for its erection has been deferred.

In connection with the offer of a gift of £500 from Mr. Richard Williamson in aid of engineering research, a number of suggestions for subjects were received. The one which the council selected was on the best form and material for pistons and piston-rings, especially for internal combustion engines, and they are awaiting the approval of the Department of Scientific Research through which Mr. Williamson's offer was transmitted.

A PREHISTORIC PUEBLO INDIAN RUIN

THE American Museum of Natural History, in the summer of 1916, entered upon the largest single piece of scientific excavation ever undertaken in the United States. This was the systematic excavation and reparation of one of the finest and best preserved examples of prehistoric Pueblo architecture in the Southwest. The ruin is located in the Animas Valley in northwestern New Mexico, a few miles below the Colorado boundary and directly across the river from the town of Aztec, and is popularly, though inaccurately, called the "Aztec Ruin." It is the property of Mr. H. D. Abrams, of Aztec, who has given the Museum a concession to clear out and investigate the entire ruin. The funds for carrying on the work have been contributed by Messrs. Archer M. Huntington and J. P. Morgan.

The "Aztec Ruin" was once a typical pueblo, or great fortified house and village, comparable in the number of people sheltered to the modern American apartment house, but differing from it in that the principle of the pueblo was close communal cooperation. The buildings were so joined as to enclose three sides of a rectangular court whose fourth side was protected by a low, outcovering wall. Only one entrance led through the outer wall into the pueblo, which was, therefore easily defended. The three buildings, rising sheer from the ground on the outside, with very small windows, rose within the court by receding steps, each a story high. Interior stairways were not in use, access being gained to upper levels by movable ladders. As a military contrivance, this plan could hardly have been improved upon, since an enemy would be forced to make not one, but a series of attacks, to get possession of the building.

Although the work of investigation has as yet been only partially completed, the features of the ruin itself, and the surprising finds which have been made within the crumbling walls, have proved of sufficient importance to surpass the most sanguine expectations of the investigators. Necklaces of shell and turquoise, agate knives, pottery vessels of varied form and ornamentation, cotton cloth and woven sandals are among the gems of prehistoric Pueblo art which have recently been

unpacked in the laboratories of the American Museum. The work has been supervised by Assistant Curator N. C. Nelson, under the immediate direction of Mr. Earl H. Morris, also of the American Museum.

The seventy thousand specimens already recovered from the Aztec Ruin constituted one of the most complete collections representative of a prehistoric North American culture which have thus far been obtained. Trained preparators are working with the material, and in the near future a representative selection will be placed on exhibit in the Museum's Southwest Hall.

One of the most important phases of the explorations at Aztec is the repair and preservation of the ruin. As fast as the walls are uncovered, masons replace the stones which have disintegrated, and strengthen the portions of the structure which threatened to collapse. The intention is to make of the ruin a permanent monument to the aborigines of the Southwest rivalling in importance the Mesa Verde National Park.

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND THE McKAY BEQUEST

President Richard C. Maclaurin in his annual report to the corporation of the Massachusetts Institute of Technology in referring to the recent decree of the Supreme Court with reference to the agreement between the Institute and Harvard University says that this agreement marked an epoch in the history of educational progress in this country. The end sought was to build up an educational machine more useful to the community and to the nation than anything that could be maintained by either the institute or the university, acting independently. Dr. Maclaurin writes:

> The plan adopted by the two corporations nearly three years ago has in the meanwhile been put to the actual test of experience and has met that test well. Most, if not all, of the difficulties that were anticipated by some have either not presented themselves at all or have been easily overcome. The educational power both of the institute and the university has been greatly strengthened and the cause of science that is applicable to the service of man greatly promoted by this combination of forces. . . . Unfortunately, however, the funds that the university has at its disposal for the promotion of the great science of engineering are almost wholly dependent on the income from the Gordon McKay Endowment, and the Supreme Court has decreed that this income can not be applied in the manner indicated by the agreement. . . .
>
> It remains to be seen whether another plan can be drawn up that is equally or nearly equally, workable and effective as an educational instrument and that accords with the view of the court regarding Mr. McKay's intentions. We should be false to our educational trust if we did not give this matter due consideration and earnestly seek a satisfactory way out. If intimate cooperation between these two institutions was demanded by the exigencies of the situation before the war, it is still more urgently demanded now. With the serious problems that this nation must face during the war and the equally serious problems that must be dealt with in the period of reconstruction thereafter, needless duplication of effort and needless dissipation of energy would be in a high degree reprehensible. . . .
>
> As far as the institute is concerned in the near future the abandonment of this agreement would be much less serious in its financial aspects than seems generally to be supposed. This arises from the fact that the actual amount of income available from the Gordon McKay Endowment has been greatly exaggerated in certain quarters. According to the testimony before the court, all that the university has available at present is the income from less than two and one quarter millions. Under the agreement Harvard does not turn any of this income over to the institute, but appropriates a portion of it for the maintenance of courses leading to Harvard degrees, these courses being conducted at the institute. The amount thus appropriated since the agreement went into operation has been $100,000 annually, the major part of this having been employed in paying the salaries of the university's professors and instructors. The whole amount is less than one tenth of the annual expenditure of the institute. It must not be supposed, therefore, that the institute will be crippled financially if the agreement with the university is abandoned.

THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

The American Philosophical Society will hold its annual general meeting at Philadelphia on April 18, 19 and 20. Dr. William B.

Scott, professor of zoology at Princeton University, will preside, succeeding Dr. W. W. Keen, who after ten years of distinguished service would not permit himself to be reelected.

The general lecture will be given in the hall of the Historical Society of Pennsylvania on the evening of April 19, by Lieutenant Colonel R. A. Millikan, of the Department of Science and Research of the Council of National Defence, whose subject will be "Science in relation to the war."

The annual dinner will be held at the University Club, on the evening of April 20.

On the afternoon of April 20, there will be a symposium on "Food-problems in relation to the war" the program of which is as follows:

Introductory Remarks, by Herbert C. Hoover, B.A., U. S. Food Administrator, and by Alonzo E. Taylor, M.D., professor of physiological chemistry, University of Pennsylvania.

"Physiological effects of prolonged reduced diet on twenty-five men," by Francis G. Benedict, Ph.D., ScD., director of the Nutrition Laboratory of the Carnegie Institution of Washington.

"Food conservation from the standpoint of the chemistry of nutrition," by Henry C. Sherman, Ph.D., professor of food chemistry, Columbia University, New York City.

"Some economic aspects of the American food supply," by J. Russell Smith, Ph.D., professor of industry, Wharton School of Finance and Commerce, University of Pennsylvania.

"Food control and food conservation in the United States Army," by John R. Murlin, major, Sanitary Corps, N. A.

SCIENTIFIC NOTES AND NEWS

At a meeting held on March 19, the Academy of Natural Sciences of Philadelphia elected as correspondents, John H. Comstock, Herbert S. Jennings, Frank R. Lillie, Alfred G. Mayer, John C. Merriam, George H. Parker and Charles R. Van Hise.

At a meeting of the Rumford Committee of the American Academy of Arts and Sciences held on March 13 last the following grants for research were voted: To Professor F. K. Richtmyer, of Cornell University, in aid of his researches on the optical properties of thin films (additional to a former appropriation), \$500. To Professor Arthur L. Foley, of the University of Indiana, for his research on the photography of the electric spark at different periods of its history, \$150. To Professor Orin Tugman, of the University of Utah, for his research on the conductivity of thin metal films when exposed to ultra-violet light, \$100.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Charles Bolton, Henry C. H. Carpenter, Thomas A. Chapman, Gerald P. L. Conyngham, C. Clifford Dobell, Ernest Gold, Henry B. Guppy, Albert G. Hadcock, Archibald V. Hill, James C. Irvine, Thomas Lewis, Srinivasa Ramanujan, Arthur W. Rogers, Samuel Smiles and Frank E. Smith.

The Paris Academy of Sciences has elected two national correspondents for the sections of anatomy and zoology. M. Vayssière, professor of the faculty of sciences at Marseilles, has been elected to take the place of the late M. Renaut, and M. Cuénot, professor at the University of Nancy, has been elected to take the place of the late M. Maupas.

The introduction of compulsory rationing in Great Britain and the discontinuance of the voluntary propaganda department has led the food controller to reorganize the food economy division of the ministry hitherto conducted by Sir Arthur Yapp. It will now consist of four branches: public services food consumption, national kitchens, public catering, and an educational branch under the direction of Professor E. H. Starling, F.R.S. The coordination and control of the departments will be exercised by a Food Survey Board, of which the directors of the several departments will be members, with Lieutenant Colonel A. G. Weigall, M.P., as chairman.

Professor W. W. Watts, professor of geology at the Imperial College of Science and Technology, has been elected a member of the Athenæum Club, London, for "eminence in science."

MR. R. BULLEN NEWTON, of the geological department, British Museum (Natural History), has completed fifty years active government service. During the earlier part of his official career, which commenced on January 6, 1868, Mr. Newton was one of the assistant naturalists of the Geological Survey under the late Professor Huxley. He was transferred to the British Museum in August, 1880, at the time of the removal of the Natural History Collections to Cromwell Road.

PROFESSOR C. H. LEES has been elected president of the Physical Society of London. The Vice-presidents are Professor J. W. Nicholson, Professor O. W. Richards, Dr. S. W. J. Smith and Dr. E. W. Sumpner.

PROFESSOR TUFFIER, of Paris, has been promoted to the rank of commander of the Legion of Honor in recognition of his eminent services as consulting surgeon to the French armies.

MAJOR J. G. FITZGERALD, associate professor of hygiene and director of the Connaught and Antitoxin Laboratories in the University of Toronto, has left for active service overseas in the Royal Army Medical Corps, having been transferred from the Canadian Army Medical Corps.

DR. WILLIAM P. WOOD, assistant professor of chemical engineering at the University of Michigan, has resigned, to join the Signal Corps of the Army.

CAPTAIN LAWRENCE MARTIN, National Army, ordinarily associate professor of physiography and geography at the University of Wisconsin, is on duty in the Military Intelligence Section, War College Division, Office of the Chief of Staff, War Department, Washington, D. C. He has charge of the map room at the War College and of the maps in the offices of the War Council and of the Chief of Staff, and does geographical work for the General Staff in the combat branch of the Intelligence Service.

ACCORDING to the *Journal* of the American Medical Association Dr. Edgar M. Green, of Easton, Pa., a member of the advisory board of the state health department, is mentioned as the probable successor of the late Dr. Samuel G. Dixon, health commissioner of Pennsylvania.

F. B. HOWE, M.S. (Iowa State College '16), has accepted a position as land classifier with the U. S. Geological Survey.

ON the evening of February 20, Dr. Edmund Otis Hovey, curator of geology in the American Museum of Natural History, gave a lecture at Mount Holyoke College on the subject, "Two years' experience in the Arctic with the Crocker Land Expedition."

PROFESSOR H. C. SHERMAN, of Columbia University, spoke to the Virginia Section of the American Chemical Society at Richmond, on March 15, and at the Randolph-Macon Woman's College, Lynchburg, on March 16, on "The food situation from the viewpoint of nutrition."

THE fourth Guthrie Lecture of the Physical Society of London was delivered on March 22, at the Imperial College of Science, South Kensington, by Professor J. C. McLennan, of the University of Toronto. The subject was "The origin of spectra."

THE *Journal* of the American Medical Association states that the attention of the Surgeon-General of the United States Public Health Service has been called to the fact that men from the military service who are carriers of various infectious diseases, particularly meningitis, have been discharged into the civil communities of the country. Dr. Oscar Dowling, president of the Louisiana State Board of Health, has made a particularly strong protest against this action by the government authorities, calling attention to specific instances in which meningococcus carriers have been discharged from the service.

UNIVERSITY AND EDUCATIONAL NEWS

A FELLOWSHIP in physiological chemistry has been established at the University of Chicago by the Fleischmann Company, of Peekskill-on-Hudson, New York, for the purpose of in-

vestigating some of the scientific questions which have arisen in the course of the manufacture of compressed yeast under present war conditions. The university has appointed the first fellow on this foundation, who is now engaged in research upon the problems.

DR. WILLIAM M. JARDINE has been appointed president of the Kansas State Agricultural College and entered upon his duties on March 1. Dr. Jardine had been connected with the college for about eight years, first as professor of agronomy and for five years as dean of the division of agriculture and director of the Agricultural Experiment Station.

DR. F. E. DENNY, of the University of Chicago, has been appointed research assistant in horticulture in the Oregon Agricultural College, to fill the vacancy left by the resignation of Mr. Magness, the appointment to take effect on April 1.

DR. HELEN M. GILKEY, of the University of California, has been appointed assistant professor of botany and curator of the herbarium in the Oregon Agricultural College, to succeed the late H. S. Hammon.

DR. ETHEL M. TERRY, of the department of chemistry of the University of Chicago, has been appointed to an assistant professorship.

DR. FRED W. UPSON, for the past four years professor of agricultural chemistry in the Nebraska College of Agriculture, will, on June 1, become head of the department of chemistry in the University of Nebraska. A chemical laboratory which is modern in every respect, will be ready for occupancy at that time.

DISCUSSION AND CORRESPONDENCE

AN APPARENTLY NEW PRINCIPLE IN THE FLOW OF HEAT

SUPPOSE a number of horizontal metallic strips are maintained at constant temperatures, the first one at a low temperature, the next at successively higher temperatures, the last one being at the maximum temperature of a Bunsen flame, say a white heat. Let them all be of the same metal and have like surfaces.

Now suppose the same Bunsen flame be applied under like conditions to each strip. According to text-books and the laws of the transference of heat as usually taught, one would be led to believe that the coldest one should absorb the heat from the flame most rapidly, the next one less rapidly, and so on. Tests made by the writer, however, show this to be an error and that up to a certain high temperature exactly the reverse is the case; the coldest one will absorb the least amount of heat from the flame, the next hotter one will absorb more and so on up to a temperature at which the rate of absorption will be a maximum, after which it diminishes again, becoming zero for the one whose temperature is equal to that of the flame.

As stated in the premises, the heat which enters the metal from the flame is supposed to be conducted away as fast as it enters, and it is this heat which is measured. This could be carried out by using flat-bottomed iron cups or crucibles containing various materials having successively higher but fixed boiling points, say like liquid air, water, sulphur, zinc, etc.

When a very hot gas, like that in a flame, impinges on a relatively very cold surface from which the heat is led off as fast as it enters, like in the boiling of water by flame heat, a peculiar phenomenon takes place in that the equivalent of a very thin film of extremely high thermal resistance is formed on the surface exposed to the flame. Considered as a thermal resistance, the writer finds that for a constant temperature flame its resistance decreases rapidly as the temperature of the absorbing surface increases, contrary to what would have been supposed. The transmission of heat therefore increases as the absorbing surface becomes hotter and reaches a maximum which appears to be roughly when the drop of temperature from the flame to the surface is equal to that from this surface to the constant temperature boiling liquid; the transmission then must fall again, becoming zero when the temperature of the boiling liquid is equal to that of the flame. This increase of temperature of the surface (to about a red heat when water is being boiled) can be brought about by inserting a properly pro-

portioned thermal resistance between the heat-receiving surface and the boiling liquid. This was shown by the writer in an article on "A New Principle in the Flow of Heat" in the *Journal of the Franklin Institute,* January, 1918, page 75, and another in *Power* for January 1, 1918. In this way the writer has transmitted heat from a flame to water from 25 to 30 times as fast through the same area of surface.

It seems likely that this supposed high-resistance film is not a true thermal resistance, its estimated resistivity being many times that of good insulators like felt, but that the true explanation is that when hot gases impinge on a relatively very cold surface much of the heat is reflected and but little is transmitted. Perhaps the transference of the momenta of the moving molecules constituting heat is the explanation, in which case that part of the energy which is not transmitted is reflected.

CARL HERING

PHILADELPHIA, PA.,
February 15, 1918

THE AURORA OF MARCH 7, 1918

THOSE who saw the aurora of August 26, 1916, did not expect to see such a display repeated within a life time, but on March 7, 1918, there was a similar spectacle which from reports must have been visible over practically all of the northern hemisphere of the earth. I first noticed the aurora low down in the north, about 7 P.M., but in half an hour clouds had come, which continued for an hour or so. At 9.30 I happened to be out of doors and saw that something startling was in prospect, as the sky was clear and the aurora was growing rapidly. The general effect and appearance of the display was accurately described by Dr. Tomlinson of our geology department,[1] and I shall limit my account to the determination of the position of the radiant or apparent focus of the auroral streamers. It was very striking that just when the display was at its maximum the streamers seemed to come from Saturn.

In the following notes Central Standard Time, 6 hours slow of Greenwich is used, the position being latitude 40° 6′ north, longitude 88° 13′ west.

9h. 31m. Streamers rising. Cloud-like form in southeast.

9h. 36m. Radiant exactly at Saturn. Half of sky or more covered. To west and over Jupiter a broad band of red, 10° or 15° wide. This is southern edge of the aurora in that direction.

9h. 41m. Radiant 2° north of Saturn.
9h. 44m. Radiant 2° northeast of Saturn.
9h. 46m. Radiant fainter.
9h. 51m. Radiant has about disappeared.
9h. 51m. All of light is now below Polaris.
10h. 38m. Only faint glow low down.

No further display was noted by our observers at the telescope, who worked until several hours after midnight.

Averaging the three estimates, we have that at 9h. 40.3m. the radiant was 1°.1 north and 0°.5 east of Saturn. The magnetic elements for Urbana are: declination 3° 13′ east, dip 71° 5′, determined by Mr. Merrymon in 1917, and kindly communicated by the superintendent of the U. S. Coast and Geodetic Survey. From the ephemeris position of Saturn, we readily find then for comparison:

	Declination	Hour Angle
Magnetic zenith	+ 21°.2	+ 1°.1
Radiant	+ 20°.1	+ 0°.2
Difference	1°.1	0°.9

The result shows that within the error of estimate the apparent radiant or focus of the auroral streamers was at the magnetic zenith, which agrees with what was observed in 1916.

JOEL STEBBINS

UNIVERSITY OF ILLINOIS OBSERVATORY

FROM reports it is learned that the aurora borealis seen here on the evening of March 7 was observed at the same hours from New York City to Salem, Oregon, also at St. Louis and as far south as Lat. 36° N., in North Carolina. It was probably seen by observers over an area of greater extent in the United States and occurred also in Europe. This synchronous occurrence seems to indicate a widespread uniformity of the atmospheric conditions which produced it and to offer additional evidence

[1] SCIENCE, March 22.

against the belief, formerly held by some, that this phenomenon is due solely to local conditions.

Here the broad central arc formed low in the northern sky, its highest point being about 20° above the horizon and identical in direction with our magnetic north. It first appeared about 8 P.M. and was then most pronounced (though without definite form) in the northwest. In color the light consisted chiefly of white, yellowish green, and dull red but was at no time very bright, though its varied radial streamers attracted much attention. Its maximum was reached about 10 P.M., when it advanced beyond the zenith to a point about 60° above the southern horizon and covered the major portion of the sky.

JOHN E. SMITH

IOWA STATE COLLEGE,
AMES, IOWA,
March 18, 1918

ON the evening of March 7 there occurred at La Crosse, Wisconsin, the finest display of northern lights that the writer has ever seen here. There seems to be no record or remembrance of any equal display. The lights were observed more or less from 7:30 till 12 P.M. The best were seen from 9:45 to 10:45 P.M. During this time shafts of light starting from the horizon would shoot to the zenith. These shafts would be in the north, northeast, or northwest. After these started, others would follow them till three fourths of the heavens were covered with these shafts of light, for they extended south of west and south of east. In the parts of the heavens farthest south the shafts of light were broken just below the zenith but in the other parts of the heavens the shafts were continuous from the horizon to the zenith. The shafts did not flicker or flash as observed at other times but they remained stationary for a period and then died out.

The most remarkable thing was the colors exhibited. After the shafts had been established faint tinges of red appeared which became brighter till the heavens from the northwest to the northeast, and for three fourths of the way from the horizon to the zenith were covered with a bright crimson red glow. The scene was magnificent and never to be forgotten.

The above light forms would stay for some minutes and then they would all die away and leave only a greenish hue in the north. In a few minutes more all would be repeated again. This repetition was noted several times in succession till about 10:45 it all faded into the greenish hue which lasted an hour.

Other colors were observed as yellows and purples. These were seen as faint light toward the zenith but the prominent color was the red which with the definitely formed shafts gave a special character to these northern lights which will be easily remembered by the observers. G. H. BRETNALL

STATE NORMAL SCHOOL,
LA CROSSE, WIS.

AN OLD RECORD OF ALBINO TURKEY BUZZARDS

THE appearance in SCIENCE at intervals during the past two or three years of accounts by various observers of albino birds has interested the present writer very much, and all the more because he has never been so fortunate as to see such a bird. Recently while reading the voyages of Captain William Dampier, his attention was forcibly called to the account by this keen-eyed explorer which is given herewith in the belief that it may prove of interest and value to some of the readers of SCIENCE.

> Carrion crows are blackish Fowles, about the Bigness of Ravens; they have bald Heads and reddish bald necks like Turkeys. . . . These live wholly on Flesh (and are therefore called Carrion Crows). . . . Some of the Carrion Crows are all over white, but their Feathers look as if they were sullied: they have bald Heads and Necks like the rest; they are of the same Bigness and Make; without any Difference but in Color; and we never see above one or two of these white ones at a time; and 'tis seldom also that we see a great Number of the black ones, but that we see one white one amongst them. The Logwood-Cutters [of Campeachy] call the white ones King-Carrion Crows.

This account is found on page 168 of Volume II. of the 1729 edition of Dampier's "Voyages" as edited by John Masefield and

published by Richards in London in 1906. Specifically the account is found in Dampier's narrative of his "First Voyage to the Bay of Campeachy" which is dated 1676. Dampier was, of all the early English ship captains and circumnavigators, by far the keenest observer. His "Voyages" fairly bristle with the most interesting and valuable natural history notes, and it seems not improbable that if they were better known they might constitute his best bid for fame. His text seems to indicate quite clearly that these "Carrion Crows" are our well-known "Turkey Buzzards," and if so it may be that this is the first and possibly the only recorded occurrence of albinos among them.

E. W. GUDGER

STATE NORMAL COLLEGE,
GREENSBORO, N. C.

AN OPEN LETTER

My dear Professor Jeffrey: In your delightful volume (excuse the word, but it expresses my feeling) on Woody Plants, you make a division of Archigymnospermæ and Metagymnospermæ on the basis of pollen chamber, fertilization by motile sperms, and presence of cryptogamic wood. In other places you show the close relationship of Cordaitales, Ginkgoales and Coniferales. Could you explain briefly, in this journal, for the benefit of many who will undoubtedly be interested, why you split the gymnosperms between the Ginkgoales and Coniferales rather than between the pithy stemmed Cycadean series and the woody Cordaites-Ginkgo-Conifer series?

Sincerely yours,
HENRY S. CONARD

Dear Professor Conard: Your open letter has been submitted to me by the editor of SCIENCE. My motive in dividing the Archigymnospermeæ from the Metagymnospermeæ on the basis of the presence of antherzoid fertilization and cryptogamic centripetal wood is largely one of expediency, since there are fortunately almost no gaps in the series of vascular plants outside the very considerable one which separates the Angiosperms from the Gymnosperms. The cryptogamic wood (or the *bois centripete*) has been an important criterion for the lower gymnosperms since the days of Renault and Brongniart. Zoidogamy, predicted by Hofmeister for the lower gymnosperms and discovered in the Cycads and Ginkgo by Hiarase Ikeno and Webber is a prominent character on the gametophytic side. The combination of these two accepted criteria makes the line of separation come above the Ginkgoales. The large pith and large leaves which you emphasize were also possessed by many Cordaitean forms. Some of these had leaf bases very fern-like in organization, as described by Dr. D. H. Scott and myself in remains from the lower Waverly of Kentucky. I would repeat that the term Archigymnospermeæ is one of convenience, and like most scientific terms falls short of covering the situation. I would quite agree with you that the Ginkgoales are fully as closely allied to the Coniferales as to the Cordaitales, yet convenience and the present state of our knowledge includes them with the ancient gymnosperms. I may add that your "Cycadean Series" appears to me to be a very natural one, and in fact is generally admitted. Hoping I have made my position clear I remain,

Yours sincerely,
E. C. JEFFREY

SCIENTIFIC BOOKS

Studies in the History and Method of Science. Edited by CHARLES SINGER. Oxford, Clarendon Press, 1917. xiv + 304 p. 4°, XLI plates (many colored), 33 illustr. in text.

As Sir William Osler tells us in the introduction to these essays, they are the outcome of a quiet movement on the part of a few Oxford students to stimulate a study of the history of science. Upon the generous initiative of Dr. and Mrs. Charles Singer, a bay has been set apart in the Radcliffe Camera of the Bodleian for research work in this field. The objects pursued are: first, to place at the disposal of the general student a collection that will enable him to acquire a knowledge of the development of science; secondly, to assist the special student in research: (*a*) by placing him in relationship with investigations adready undertaken, (*b*)

by collecting information on the sources and accessibility of his material, (c) by providing him with facilities to work up his material.

In spite of Dr. Singer's absence on military duty, the work has been carried on with conspicuous success. Ten special students have already used the room: Ramsay Wright has made a study of a Persian medical MS.; Walter Libby of Pittsburgh, during the session of 1915–16, collected material for his well-known book on the history of science; E. T. Withington is investigating the Greek medical texts for a new edition of Liddell and Scott's dictionary. Miss Mildred Westland has helped Singer with the Italian medical MSS. Reuben Levy has worked at the Arabic medical MSS. of Maimonides. Mrs. Jenkinson is engaged on a study of early medicine and magic. J. L. E. Dreyer has used the room in connection with the preparation of the "Opera Omnia" of Tycho Brahe. Miss Joan Evans is engaged upon a research on medieval lapidaries. Mrs. Singer has begun a study of the English medical MSS., with a view to a complete catalogue.

This is a splendid beginning—the right beginning—and one can not bestow too much praise on Dr. and Mrs. Singer for their enthusiastic and contagious activity.

This volume of essays is issued as a *ballon d'essai*, but we earnestly hope that a well-deserved success will encourage its editor to publish periodically a similar one. That this first one has been issued at all, and "got up" with such admirable scholarship and taste in the fourth year of the war, is a credit to Oxford.

One half of the book is Singer's own work. He has contributed two very important studies. One on the scientific views of Saint Hildegard. The author traces the sources of her knowledge, by no means an easy task, one whose accomplishment implies a great familiarity with medieval science. It is interesting to compare this study with earlier ones devoted to the same subject: it illustrates the whole difference between historical studies of the old literary type and those permeated with the scientific spirit—a genuine understanding of scientific problems and values. The other is a study in early Renaissance anatomy with a new text: the Anothomia of Hieronymo Manfredi (1490). Both studies are very accurate, clear and complete; they are magnificently illustrated.

There is a suggestive paper on vitalism[1]—in fact the most comprehensive short statement of this question which I have read—by the much lamented John Wilfred Jenkinson, (with a portrait). Dr. Jenkinson was killed in action in 1915, at the Gallipoli peninsula. He had already produced excellent embryological work, but was still very young and his friends had placed considerable faith in him.

I must quote more briefly the other papers: Raymond Crawfurd deals with "The blessing of cramp-rings. A chapter in the history of epilepsy." E. T. Withington's essay is devoted to one of the most clear-minded men of the sixteenth century: Dr. John Weyer, the first serious opponent of the witch-mania. Any one acquainted with the history of witch-craft will at once appreciate his greatness. Most historians probably know very little about him, and yet this man was far greater than the contemporary kings and princes about whom they know and tell us so much. And do you think it was by mere coincidence that the first opponents of the witch-mania were scientists? Reuben Levy shows that the "tractatus de causis et indicis morborum" attributed to Maimonides, is most likely not his own work. Lastly there is a long essay by F. C. S. Schiller: "Scientific Discovery and Logical Proof." Interesting as it is, I think that this paper is here somewhat out of place. A book chiefly devoted to the history of science, should only harbor such philosophical and methodological studies as are based on historical information.

The publication of this book is highly gratifying. It proves that in England, as well as in Italy, France and Germany, the idea of the history of science is crystallizing and growing fast.

In America also, the year 1917 has brought to light some important contributions to this movement. I refer to the publication of two

[1] It is a revised edition of a paper published in the *Hibbert Journal*, IX., 545–559, 1911.

remarkable text-books. The first in point of date is Walter Libby's "Introduction to the History of Science" (Boston, Houghton Mifflin), a very well written and interesting account of some of the most typical conquests of science throughout the ages. The second is Sedgwick and Tyler's "Short History of Science" (New York, Macmillan), whose more ambitious purpose is to outline the whole of its development. The authors have been teaching the history of science for a great many years at the Massachusetts Institute of Technology. They have taken great pains to make their book as serviceable as possible to the student. It contains a large number of relevant quotations, and some longer extracts from Hippocrates, Roger Bacon, Copernicus, Harvey, Galileo, Newton, Jenner, Lyell; also notes on the main inventions of the last two centuries, and chronological and bibliographical summaries.

With books like these, the American teachers will have no excuse for not knowing at least something on the subject. It is not unlikely that now that such convenient text-books are provided, courses based upon them will grow like mushrooms; those giving them will gradually become acquainted with the history of science, and some of them will wish to know more of it. That is also a beginning.

The reader should not be left under the impression that no real research work has been undertaken in this country. It will be enough to remind him of the two beautiful studies contained in the eleventh volume of the Humanistic Series of the University of Michigan. The first is an admirable edition of Robert of Chester's Latin translation of the "Algebra" of Al-Khowarizmi, with an introduction, translation, and notes by Ch. L. Karpinski (1915). The second, an English version of Nicolaus Steno's "Prodromus," with notes by J. G. Winter (1916). This volume is to be completed by an essay on the "Vesuvius in Antiquity," contributed by the editor of the series, Francis W. Kelsey.

I believe that no greater service can be rendered to the history of science, at this juncture, than by relentlessly insisting upon the necessity of raising the standard of scholarship as high as possible. It will gradually dawn upon the people that inaccurate historical facts are as worthless as inaccurate scientific facts. It is true, historical errors are less obvious. At least they are not automatically detected, as is the case in the positive sciences, where most errors lead sooner or later to inconsistencies. But does the fact that there is no material check of our accuracy in historical matters not increase—rather than decrease—our duty to be accurate?

The Past can not rise up and arrest the historian, crying out: "You inconsiderate tattler, you liar, how dare you. . . . ?" The historian is a judge. Upon his shoulders rest the immense responsibilities of a judge. And those upon whom he sits in judgment have been silenced forever.

It is not always easy to appreciate the merit of a contemporary, because we can not justly estimate the value of a discovery until we have got far ahead of it, and tasted a great many of its fruits. And so it happens all the time that some people enjoy a very high reputation, which they do not deserve, while others traverse life unrewarded and unnoticed.

From the idealistic point of view, this does not matter much, because, sooner or later, justice is done. That is the historian's trust. If he be unfaithful to it—if he says for instance that the air pump was discovered by Robert Boyle instead of by Otto von Guericke—this is not a mere trifle. It is a protracted injustice; the supreme crime.

But the ultimate purpose of those who are now fighting under the banner of the history of science—only a few to-day but legion to-morrow—is even higher. To put it briefly, their purpose is to reconcile knowledge and idealism. We need both equally. I do not know which is worst, knowledge without idealism or idealism without knowledge, and yet our whole system of education is leading to their growing estrangement.

It would be foolish to imagine that scientists and literary people, the so-called humanists, will come together spontaneously. Such a miracle will not come to pass, unless we

prepare for it. Scientists are too busy to undertake historical studies, and literary people can hardly be expected to reeducate themselves along scientific lines. A bridge must be built. The task of unification must be intrusted to specialists, equally well trained as scientists and historians. There is no other way out. Complete courses on the history of science must be organized, and at least a few men must be given the material possibility of devoting themselves entirely to this work of synthesis.

The books of which I have spoken are new tokens, among many, of the irresistible movement which is leading to the organization of these studies and we must be grateful to all those who are helping—either as scholars or as vulgarizers. It remains to be seen which university will take the lead; the others will follow.

GEORGE SARTON

INVERTEBRATE PALEONTOLOGY

IN 1879 Hall described in a Report of the New York State Museum a curious fossil from the Silurian, giving it the name *Camarocrinus stellatus*. It was a large globose structure, internally divided into several chambers, attached at one end to a stem agreeing with that of the crinoids. Hall surmised that it represented the base of some crinoid species, the other end of the stem, with its calyx, being still unknown. This explanation was generally accepted, but the peculiar chambered bulbous form was supposed to represent a special adaptation for a floating mode of life, the bulb being in fact a float, from which the crinoid hung suspended in the water. In 1904 Dr. R. S. Bassler, of the U. S. National Museum, found an apparently promising locality for *Camarocrinus* a few miles north of Cape Girardeau, Mo., along the bluffs of the Mississippi River. This led Mr. Frank Springer in 1912 to send Mr. F. Braun to the locality, with the result of uncovering the most marvelous specimens of crinoids, completely solving the mystery of *Camarocrinus*, and furnishing the National Museum with a slab about 4 by 5½ feet, covered with remains of the animals. This slab, now mounted in the hall of invertebrate paleontology, will always remain one of the most striking paleontological specimens in existence, for it shows the animals as they died, probably smothered by a deposit of mud brought by a swift current from some higher level. Mr. Springer has prepared a detailed and beautifully illustrated account of the new materials, and has taken occasion to review all the congeneric species found in America.[1]

It turns out that *Camarocrinus* is the basal end of a well-known crinoid, described first from Bohemia by Zenker in 1833. Zenker called it *Scyphocrinites*, and according to the rules of nomenclature this is the proper name, but students of crinoids have chosen to shorten such names, in the present case writing *Scyphocrinus*. The Missouri slab proves to belong to Zenker's original species, *S. elegans*, the American specimens agreeing in all respects with those from Bohemia. The basal bulb was not afloat at all, but was embedded in the mud, acting as a root. In its resemblances to and differences from the calyx end it suggests some interesting reflections in connection with the researches of Professor C. M. Child, of Chicago. To what extent is it purely adaptive, and how much of its form and structure depends upon a principle of partial repetition of the fundamental structure of the animal?

Although the Missouri slab represents the Bohemian species, Mr. Springer finds that there are no less than seven other forms of *Scyphocrinites* (or, as he writes it, *Scyphocrinus*) in American rocks. *S. stellatus* is Hall's original *Camarocrinus*; *S. pratteni* is a very fine species from Tennessee, described under another generic name by McChesney as early as 1860; *S. ulrichi* was described by Schuchert as a *Camarocrinus*; and finally *S. spinifer*, *S. mutabilis*, *S. pyburnensis* and *S. gibbosus* are published as new by Mr. Springer.

The Carboniferous (Pennsylvanian) rocks of Maryland, Pennsylvania, West Virginia and Illinois have in recent years yielded a most interesting assemblage of fossil insects, which

[1] Frank Springer, "On the Crinoid genus *Scyphocrinus* and its Bulbous Root *Camarocrinus*, Washington, Smithsonian Institution, 1917, 74 pp. and nine plates.

seem likely to afford important aid in working out the stratigraphy, and also to throw new light on the relationships between the faunæ of the old and new worlds in Carboniferous time. Many of the American species, though described and figured, still await publication. In the meanwhile, it is satisfactory to find that, in spite of the war, the insects of the European coal-measures are being fully described and well figured by Mr. Herbert Bolton, of the Bristol Museum. The apparent poverty of England in fossil insects of Paleozoic age may prove illusory, due merely to lack of interest in their discovery and identification. At all events, Mr. Bolton is making known a number of new types, his latest paper on this subject[2] containing accounts of new species, and a very fine new genus, for which he unfortunately uses the preoccupied name *Palaeomantis*. In another paper[3] Mr. Bolton gives an account of some insects from the coal measures of France, describing among other things the singular new genus *Megagnatha*, which appears to have long slender jaws, recalling those of the modern *Corydalis* male. The name *Megagnathus* has been applied to a genus of beetles, but it is to be hoped that no one will think it necessary to alter the name of Mr. Bolton's genus. Those who propose to change names in zoology, merely because they are thus similar, can hardly understand what confusion would result from the universal application of such a method. We all agree that absolute homonyms can not be permitted to stand, but a difference in the ending of the word is abundantly sufficient to prevent confusion. In connection with the evolution of cockroach types in America and Europe, particular attention must be called to Mr. Bolton's *Neomylacris lerichei*, which certainly has a strongly American facies. I should call it *Promylacris lerichei*, referring it to a genus described from Mazon Creek, Illinois.

[2] "On some Insects from the British Coal Measures," *Quart. Jour. Geol. Society*, Vol. 72 (1916), pp. 43–62.

[3] "The Mark Stirrup Collection of Fossil Insects from the Coal Measures of Commentary (Allier), Central France," *Mem. Manchester Lit. and Phil. Society*, May 11, 1917.

While the European Paleozoic insects are thus being elucidated, very welcome information reaches us from Australia, of the discovery of a rich fauna of Mesozoic insects.[4] It appears that the specimens represent a Triassic fauna, and consequently tend to complete our ideas of insect phylogeny, filling in a gap which has hitherto existed in the record. One of the Neuropteroid faunas is referred by Mr. Tillyard to a new order, Protomecoptera, having the surface of the wings finely reticulated. In modern *Panorpa* traces of the primitive reticulation can be seen in a good oblique light, and it really seems unnecessary to recognize more than a superfamily (Archipanorpoidea).

T. D. A. Cockerell
University of Colorado

SPECIAL ARTICLES

THE EVOLUTION OF BACTERIA

Dr. I. J. Kligler has recently contributed a paper on "The evolution and relationship of the great groups of bacteria."[1] The conclusions reached are so surprising and so in conflict with commonly held opinions that the contribution is well worthy of careful scrutiny to determine whether or not the premises are reasonable, and the deductions logical. It appears to the writer that in several instances Dr. Kligler has failed to prove his points and that his conclusions, at least when based upon the premises and the reasoning used, are open to serious question.

Probably no fault can be found in the introductory statement that the bacteria are "among the most primitive of living forms." It should be remarked, however, that this does not prove that the present living bacteria are any of them identical with, or even closely related to, the original types of bacteria which appeared upon earth. The next statement can not be accepted quite so readily. The author says:

[4] R. J. Tillyard, "Mesozoic Insects of Queensland," *Proc. Linn. Soc. New South Wales*, July 11, 1917. Also publication 253, Queensland Geological Survey (1916).

[1] *Journal of Bacteriology*, March, 1917.

The ability of some types to subsist on simple inorganic substances (CH_4, NH_3 and CO_2) without the aid of sunshine, and the sensitiveness of all bacteria to the action of sunlight suggest their existence on this planet prior to the appearance of plant life or the penetration of the rays of the sun through the volcanic vapors.

We may perhaps agree that an organism which can develop without organic compounds of any kind, utilizing inorganic compounds exclusively, would probably be primitive. There is no proof, however, that the original bacteria were any more sensitive to the sun's rays than are plant cells in general at the present day. It is not improbable that the purple sulphur forms are among the most primitive of our modern bacteria, and these, as is well demonstrated by the work of Molisch and others, grow only in the presence of light, and the motile forms show a very marked positive phototaxis. Most animal cells are equally sensitive to sunlight with most bacteria, but this does not argue that these animal cells are primitive. Finally, the assumption that life must have originated on earth while the earth was still bathed in volcanic vapors, and the earth's surface was dark, has little to substantiate it. It is quite as probable that we must account for the development of life upon earth on the basis of Chamberlain's accretion theory as on the theory of a once molten globe. It is not argued that either hypothesis of earth origin must be accepted, but Dr. Kligler's assumption is rather an insecure basis for the erection of his complex superstructure.

It is rather difficult to follow Dr. Kligler's reasoning through the succeeding paragraph. The thesis to be proved apparently is: "The intimate dependence of both plants and animals on bacteria and their activities tends to strengthen the conviction that these microorganisms must have preceded the others." The statement may well be accurate, but the examples adduced are not in all cases fortunate. For example: "Plants can not subsist without nitrates" is misleading, for many of the higher plants, fungi, yeasts, algæ, etc., utilize ammonia quite as well as nitrates, in some cases utilizing ammonia in preference. To state that in arid regions where plant life is absent bacteria are also absent is simply to affirm that both bacteria and higher plants require water for their growth, or are killed by an excess of salts in the soil rather than that the higher plants are dependent upon the bacteria. The author's examples of the necessity of bacteria for the growth of animals are likewise not convincing as proof.

Attention is next called to the fact that with the bacteria evolutionary changes may be physiological as well as morphological, and the point is made that these "adaptive modifications" should be traced.

The statement that "Bacteria need only minute amounts of nitrogenous food but require a relatively enormous quantity of energy-yielding (carbon) compounds" is doubtless true for many of the fermentative types, but there seems to be no more reason for this assertion for primitive bacteria than for higher plants, or the fungi. Then it is argued since most bacteria, at least the saprophytes, can utilize nitrogen either as NH_4, or NO_3 and show the most diverse ability to use various carbohydrates, then the first path of early evolution must have been increasing ability to use a variety of carbohydrates, and only later, when a higher scale of development is reached do we find increasing power to utilize complex nitrogenous compounds. No evidence is adduced that the primitive organisms were furnished with abundance of carbohydrates before they had opportunity to attack considerable quantities of protein or other complex nitrogenous substances. It should be emphasized that carbohydrates in the sense used and in quantity needed would probably be produced only by higher plants. But all plants contain protoplasm, and in their decay organisms have access to proteins as well as to carbohydrates. In spite of the array of supporting evidence, it seems that there is no adequate proof that utilization of carbohydrates is any more primitive a function than is proteolysis.

The point is made that there are four principal types of primitive oxidizing bacteria,

those which oxidize C, N, S and Fe, then follows the statement:

> It seems fairly certain from the important part played by carbon compounds in the vital activities of our common bacteria, especially as a source of energy, that the carbon oxidizers are the forerunners of the bacteria of to-day.

The author then concludes that the most primitive types must be those capable of oxidizing methane, followed by those which oxidize carbon monoxid, and, most astounding, those capable "of utilizing CO_2." A careful scrutiny of the text will lead to no conclusion but that "utilizing" is here used to indicate "oxidizing." This inference is strengthened by a second statement even more surprising.

> Since the ammonia and nitrate oxidizers (or nitrifiers) also assimilate large amounts of carbon-dioxide (Jensen) they would seem to fall in line along with the organisms capable of *obtaining their energy from carbon dioxide.*[2]

By what mystic process an organism may secure energy from CO_2 is not explained. The assumption that carbon-oxidizing forms are most primitive is scarcely proved. In fact, study of the oligocarbophilous organisms, that is, forms which can utilize CO_2 in the building up of food or protoplasm indicates that the more primitive of the modern types may be among the nitrifying and the sulphur bacteria. An analysis of the conditions upon the earth in early times as postulated by the author and elaborated by Osborn would seem to indicate that they would be even more favorable to the development of ammonia or sulphur oxidizers than for methane oxidizers. It should be emphasized that all organisms of types not using organic carbon must have some source of energy which will enable the protoplasm to take up CO_2, replace the oxygen in part with hydrogen and build up complex organic compounds. The energy for this transformation might have come from the oxidation of ammonia or sulphur. Certainly ground waters laden with hydrogen sulphide must have reached the surface of the primitive earth much as they do to-day. Furthermore, the consistent development of the pigment bacteriopurpurin by most members of the modern large group of sulphur bacteria, together with the marked phototaxis of this group, might be interpreted as evidence that the sun's rays had some influence almost from the beginning in the explanation of energy source in CO_2 assimilation. In other words, early coordination of photosynthesis with chemosynthesis can not be ignored as a possibility.

It may be noted further that to discuss primitive bacteria as capable of utilizing formic acid, acetic acid and alcohol is somewhat anachronistic. These substances are the results of the growth or fermentative power of organisms which stand higher in the scale of evolution. Where could the primitive organisms find these complex compounds to work on?

The author next calls attention to the fact that certain organisms changed their habit of life from that of obligate aerobes, using atmospheric oxygen, to that of facultative anaerobes, "utilizing combined oxygen for intracellular combustion." The statement is made that the "prototrophic denitrifying bacteria are most probably the progenitors of this group." The statement requires some analysis. One would infer that prototrophic denitrifiers are common and well known. As a matter of fact, the denitrifying organisms are almost without exception anything but prototrophic. When one wishes to demonstrate denitrification in the laboratory it is customary to add a suitable organism to an aqueous solution of nitrate and organic carbon compounds. Under anaerobic conditions the oxygen is removed in whole or in part from the nitrogen, and used for oxidizing the carbon compounds present. The only exception to this rule known to the writer is the peculiar organism described by Beijerinck which will grow in the presence of free sulphur, nitrate and carbon dioxide in the absence of atmospheric oxygen, oxidizing the sulphur and using the energy thus gained apparently in the assimilation of CO_2. It would seem that such a form would be much more closely related to the *Thiobacteria* than to the other denitrifiers. To make his point, Dr. Kligler should cite some examples of "prototrophic denitrifiers."

[2] *Italics not in original.*

If descriptions of such organisms are nonexistent in the literature is it necessary to assume that they have not been discovered or that they once existed but have disappeared? Is it so evident that

The line of descent from the prototrophic denitrifiers is entirely clear.

The statement is made that next in series following the prototrophic denitrifiers probably came the *aerogenes* type of organism, one indication of relationship being that it can live "in simple inorganic media and under certain conditions, even to fix atmospheric nitrogen." The present writer has been unable to find any evidence that the *aerogenes* group can ever grow in a medium devoid of organic matter. It is true that inorganic nitrogen compounds may be used, but this, as was above indicated, has no particular significance, as many bacteria, yeasts, molds, algæ and even flowering plants have the same power. Any close relationship of *aerogenes* to a prototrophic form certainly has not been proved. However, the author's claim for close relationship between *aerogenes* and *coli* and through the series to the typhoid, dysentery and possibly even to the hemorrhagic septicemia groups has much to commend it, and is a generally accepted hypothesis at present among bacteriologists.

It is possible that the relationship assumed to exist between *B. proteus* and the spore-bearing rods is a real one, but the structural modification incident to the development of the power of endospore production is so great that mere association of organisms in putrefactive processes and common property of producing proteolytic enzymes does not prove close affinity. It should be borne constantly in mind that proteolytic enzymes are commonly produced by cells. Every cell has protoplasm consisting largely of protein. Cells in general after death undergo autolysis. Every cell then contains an autolytic proteolytic enzyme. The step to the production of an extracellular proteolytic enzyme would therefore seem not to be a difficult one to make, and one which may have been made independently by different groups. It might be mentioned, however, that Kligler has ignored one point of morphology which would tend to show relationship better than proteolysis, this being the diffuse arrangement of the flagella in both groups. Apparently organisms showing peritrichous flagella constitute a group rather distinct from the forms with polar flagella.

The type of pigment produced, and the general cultural and physiological characters would seem to argue quite as close a relationship between the *Rhodococcus* and *Micrococcus* and the rods producing red or yellow pigment, as between the latter and the spore-bearers or *B. proteus*. Many more resemblances than differences will be found, for example, between *Rhodococcus roseus* and the organism usually known as *Bacillus prodigiosus*.

The effort to derive the gram positive streptococci from the aerogenes types seems rather strained. Differences are more marked than resemblances. The products of fermentation are very distinct in the two groups. This fact together with decided differences in morphology, relationship to oxygen and cultural characters, counterbalance the presence of capsules of similar composition, ability to ferment inulin (in fact a variable character in *aerogenes*) and localization in the same organs of the animal body. However, it should be granted that the author's emphasis on relationship between the streptococci and the aciduric bacilli is probably well placed.

Kligler's characterization of *Azotobacter* as a form not only fixing atmospheric nitrogen but oxidizing nitrogen to nitrates is apparently not well founded. It may be noted that there is an apparent tendency to consider *Azotobacter* prototrophic, an assumption which is quite unwarranted. The statement "the *Azotobacter* can assimilate free nitrogen more readily if glucose and a small amount of ammonia are supplied" is misleading. Apparently *Azotobacter* is wholly incapable of growing, certainly incapable of fixing atmospheric nitrogen, without an abundance of soluble carbohydrate food. By oxidation of this carbohydrate, energy is secured for the fixation of sufficient atmospheric nitrogen for the needs of the cell, but there is apparently no nitrogen changed into the form of nitrates.

Furthermore it should be emphasized that this organism has very high fermentative powers, producing large amounts of CO_2 and H_2O.

That the organisms of the nodules of the legumes are closely related to *Azotobacter* is not improbable, but that there is any close relationship between *Rhizobium* and the acid-fast bacteria and the *Actinomycetes* is not so clear. It is true that the latter contention has been supported by several writers, but the fact that *Rhizobium* produces nodules on the plant roots and the tubercle bacillus causes tubercles to develop in animal tissues is no more of an argument for their inter-relationship than to claim that the nematodes producing galls on plant roots are related to the tubercle bacillus or to the *Rhizobium* for the same reason. The differences between the motile (polar flagellate) gram negative, *Rhizobium,* fixing atmospheric nitrogen, and the acid-fast gram positive, non-motile tubercle bacillus incapable of fixing nitrogen are very marked and tend to outweigh the remote resemblance of the branched bacteroids to branched tubercle bacilli.

The relationship indicated between the tubercle bacillus and the *Actinomycetes* is not at all improbable, in fact, intermediate forms have been described.

The use by the author of the name *Sporothrix* for a group of bacteria is unfortunate, and will tend to confusion.

It is surprising to find the *Micrococci* and *Staphylococci* at one extreme and *Streptococci* at the other of the classificatory scheme that is worked out. The concept is unusual, to say the least, and is scarcely supported by adequate proof to be convincing.

It would seem that the family tree of the bacteria suggested by Dr. Kligler is based upon many misconceptions and misinterpretations and can scarcely be accepted without much more adequate proof. However, there is much in the article to provoke thought and discussion, and if this is accomplished and some conclusions eventually reached, the effort put forth can scarcely be said to have been in vain.

R. E. Buchanan

The Bacteriological Laboratories,
Iowa State College

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and ninety-sixth regular meeting of the society was held at Columbia University on Saturday, February 23, extending through the usual morning and afternoon sessions. Seventeen members were in attendance. Professor H. S. White occupied the chair. The following were elected to membership: Miss M. F. Chadburne, Smith College; Mr. Mervyn Davis, Equitable Life Insurance Company of Iowa; Mr. T. C. Fry, Western Electric Company; Dr. J. E. McAtee, University of Illinois; Dr. Norbert Wiener, Albany, N. Y. Four applications for membership were received.

The following papers were read at this meeting:

J. F. Ritt: "Proof of the multiplication formula for determinants by means of linear differential equations."

Olive C. Hazlett: "On vector covariants."

P. R. Rider: "On the problem of the calculus of variations in n dimensions."

A. R. Schweitzer: "On the iterative properties of an abstract group."

A. R. Schweitzer: "On certain articles on functional equations."

A. R. Schweitzer: "On iterative function equations."

J. R. Kline: "A new proof of a theorem due to Schoenflies."

R. L. Moore: "A sufficient condition that a system of arcs should constitute a surface."

J. L. Walsh: "On the location of the roots of the Jacobian of two binary forms, and of the derivative of a rational function."

O. E. Glenn: "Covariant expansion of a modular form."

J. F. Ritt: "Polynomials with a common iterate."

L. P. Eisenhart: "Transformations of applicable conjugate nets of curves or surfaces."

S. E. Slocum: "The romantic aspect of numbers."

The San Francisco Section of the society will hold its semi-annual meeting at Stanford University on April 6. The Chicago Section will meet at the University of Chicago on April 12–13; this meeting will include a symposium on divergent series and modern theories of summability. The regular New York meeting will be held at Columbia University on April 27.

F. N. Cole,
Secretary

SCIENCE

FRIDAY, APRIL 5, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

GEOLOGY IN EDUCATION[1]

WHAT would be the result if those who are interested in education could come *de novo* to the question of the content of an ideal curriculum of study? It probably is safe to say that one of the results would be a shock to those whose opinions on this matter have been shaped by the prejudices which accompany our inheritance. That evolution is a slow process is illustrated nowhere better than in educational circles.

Let it be assumed that the consideration of what is most valuable in education could be approached by a jury which has an intelligent grasp of all subjects, as now understood, and of these subjects in their proper relations. Let it be assumed further that the jury is unprejudiced by tradition or by pronounced personal bents in favor of or against individual subjects. What conclusions would they reach? To this question there is of course no categorical answer. Wisdom would decree that there is no one model curriculum—that there should be various types of curricula, each susceptible of adaptation to individual needs.

The classes of subjects whose claims would need to be considered in such a study as that here suggested fall into several general classes. It goes without saying that their values would be differently gauged by different men, and that their values are different for different men.

Without presuming to make an exhaustive classification, it is clear that one great

[1] Address of the vice-president and chairman of Section E—Geology and Geography—American Association for the Advancement of Science, Pittsburgh, December, 1917.

group of subjects deals with men, what they have thought and what they have done, how they have moved on from one mode of thinking and doing, to other modes of thinking and doing. In the evolution of education, it came about that great importance was attached to the languages in which people recorded what they thought and did; but if we could come to this question anew, with all modern facilities for getting the things which are recorded in one language into available form in another, it is not clear that languages which are no longer in use would be regarded as vitally important for the average student. If it is important to know what was thought and done in the past, as it doubtless is, there must be scholars who command the languages in which ancient thought and ancient history are recorded. They should be our interpreters, who put into modern language the valuable part of that which is recorded in languages which are no longer spoken.

I suppose no more conspicuous example of intellectual waste can be pointed to in all the history of our unintelligent educational development than the waste of time on languages which no longer live. The stock argument that the study of these languages is helpful in the use of our own, is an argument for waste. If half the time were devoted to English, which is put upon Latin for the sake of helping English, the average student probably would advance much farther in the use of his own tongue.

What the people of long ago thought and did is of importance chiefly in its bearing on modern life. This bearing should not be belittled, and is a sufficient warrant for the study of ancient history, and of the philosophies and literatures from which our modern philosophies and literatures are descended. Yet it is easy to exaggerate the importance of even these things. Some one has told us that "history is always interesting, but rarely instructive." Such epigrams, and this one is as true as most, warn us of the futility of depending too much on the past for guidance. While history helps us in some measure to understand what is happening in the present world-crisis, yet all history, ancient and modern, plays a trivial part as compared with geography, chemistry and physics, in explanation of the course of the present war. History will in the end be invaluable in the interpretation of the war, but its importance in the crisis is slight. The dictum that history repeats itself can hardly be taken literally, or even very seriously. If it does, it repeats with variations so extraordinary that they are more prominent than the theme which they accompany. Nevertheless, that which people have thought and done is likely to remain an important element in education, and it is perhaps the sociological and economic aspects of history which are of greatest moment.

In human affairs, the past is important chiefly as a setting for the present. It is the present in which we live and move and have our being, and it is the future for which we are planning. In so far as study of the past helps us in the present, it should be cultivated. Is there adequate basis for going farther, in the average case? I believe that the most serious criticism of the old curricula, some of which still persist, is the undue proportion of time given to the languages and events of times so distant that they have little bearing on the problems of the present.

There is another class of subjects which deals with the present, with facts and conditions of to-day, and with what people are now doing and thinking. Current thought, current political, social, and in-

dustrial life, current processes in the utilization of resources, and progress in the development of principles which are to guide activities and affairs in the immediate future, these are the themes of this group of subjects. If we could free ourselves from the bias of tradition, can it be doubted that in a perfected outline of study these subjects would have a far larger place than they have had in the past, or than they have now in many institutions? Modern history, modern sociology, modern industrial life, modern economics, modern science in its application to human welfare, conservation—these are things which fit men and women for life in the present, and prepare the way for life in the future. In the successful prosecution of these studies, the languages in which the current record of their development is writ, are, of course, important.

Two years ago, I heard a Phi Beta Kappa man, just graduating from a large university, say that he felt absolutely out of touch with current affairs, that he knew far less about what people are thinking and doing, than he did when he entered college. That a normal man could make such a statement on completing a college course, seems to me a reproach to modern college education. Present-day thought, and present-day activities in connection with vital problems should, it seems to me, enter in a large way, into the curriculum of every normal student. And, for my part, I should be particular only that there be enough of the past to give a proper setting for the present, making provision always for the specialization of the exceptional student on any phase of any subject, at any stage of its evolution.

There is a third class of subjects which deals with facts and principles which have no necessary relation to historic time. The time element is involved, in many cases, in the development of facts and the evolution of principles, and in this connection it may be of vital importance. In many cases the history is interesting rather than instructive, but in others the bearing of principles and the significance of their application are revealed by their history, a history based on natural laws rather than on the caprices of men.

To this class belong most of the subjects popularly designated "science." The underlying principles are immutable, though their interpretation has changed from time to time, chiefly in the direction of completer understanding; and this change of interpretation is sure to go on, perhaps indefinitely. Once principles are established, further progress is by way of their development and enlarged application.

Most of these subjects involve an element of history which can not be ignored. There is the accumulated and accumulating body of fact on which interpretation is based. To the average student, the details of this history are not very vital, but to the specialist in any science they are vital, for in many cases facts are temporarily misinterpreted, partially interpreted, or even uninterpreted, for long periods of time. They must be stored until the time comes when they can be fitted into their proper places and their true significance grasped.

Geology belongs to this class of subjects, and among subjects of this class perhaps no one is better qualified to really educate the student.

In the first place, this is the earth we live on. It is the home of man, the only home of the only men that ever were or ever will be, so far as we now know. The past, the present, and the future of the human race, to the best of present knowledge, are bound up with it. They have been, are, and will be dependent on con-

ditions which exist here. They are intimately connected with the resources which science has discovered and learned to use, for it is reasonably certain that our progress in this direction is not ended, and quite possible that it is only well begun. Progress in the utilization of earth resources involves the results of sciences other than geology—especially chemistry and physics.

It is of course known, but not widely realized, that a large proportion of the people of the earth gets its living from the utilization of the materials of geology. The workers of the soil are not only making use of geologic materials daily, but are dependent on them. The efficiency of soil-workers would, in the long run, be far greater, if they understood how soils come into existence and how they are lost, how they are exhausted and how their exhaustion may be prevented. To supply this knowledge to soil-workers would be to increase the products of their labor, to better their condition, and to feed the rest of the world more cheaply. Have we any right to withhold such knowledge from the youth who are to deal with the soil? It is true that they learn much empirically. It is true that agricultural colleges and the Federal Department of Agriculture are supplying much useful information to large numbers of men, young and old; it is true that almost any man can gain needed information of a practical sort on these subjects, if he is well enough informed to know what he needs, and how to get it.

But in spite of state and federal efforts in this direction, large numbers of soil workers are still as ignorant as may be of the principles involved in the making and preservation of the material with which they work. Many of them are doing as their fathers did, because their fathers did it, just as we who ought to know better are still requiring or encouraging young men and women to study the things that their ancestors studied, because their ancestors studied them. No one can say how much more efficient our farmers would be, if they understood the principles of soil making, soil waste and soil exhaustion; but it is fair to infer that if they understood these things, the result would be so convincing that it would be better to neglect almost anything else rather than these things, in the education of those who are to gain not only their living, but the living of the larger part of mankind, from the soil.

Then there are the workers in mines of all sorts, who take from the earth beneath the soil the many things necessary for the on-going of modern life, and for the progress of commercial and industrial life in the future. This has been called the age of steel. It were better called the age of metals, for much besides steel is involved. The discovery of metals and fuels and progress in their utilization is tied up closely with the progress of geologic knowledge, and without the progress of geologic science the advances which have been made would not have been possible. It is of course true that in the final production of metals from ores chemistry has played an important part, but it is geology which has led the way in the discovery and exploitation of the raw material, because it has discovered the principles, or some of them, involved in their origin. It is true that geologic knowledge on the part of one man may direct the development of resources where many do the actual work; but it would be interesting to know how the mining industry as a whole would be affected, if all mine-workers understood the facts and principles involved in the origin of the materials which they extract from

the earth. How far would such knowledge go toward solving the many problems which face every mining camp, and every mining mill and smelter? How far would it go in removing labor troubles, in averting accidents, in bringing about a just distribution of profits in mining camps? To such questions specific answers are not forthcoming, but they are worthy of the most serious study, and their study may lead to a better understanding between capital and labor, and a better adjustment and an adjustment by better means, of their respective claims. Incidentally, if some of these things were better understood by those professional reformers who always take the the side of the dissatisfied, better results might be hoped for. The ignorance and therefore the incompetence of the sincerely well-disposed is one of the great obstacles to real progress.

The oil industry and all that goes with it furnishes another illustration of the importance of geologic knowledge, an importance which daily is assuming larger proportions. The rise of the cement industry is another of the great achievements of modern times in which geology has been an effective partner.

All these things concern themselves with industrial and commercial life, and what has been said may seem to place undue emphasis on material things; but I hold that these are first considerations. Men must have enough to be decent and to live decently, before their attention can be successfully directed to those things which we are pleased to call "the higher things of life." Ethics, esthetics and scientific research can hardly hope to find many effective exponents among the underfed and underclothed. In spite of what the rare individual may do, or of what the average individual may do under temporary exceptional conditions, few men, in the long run, will do much that is noble, much that contributes to progress, in the absence of something more than the mere necessities of life.

But there is quite another aspect to geology, which does not concern itself immediately with income or with industry. The study of geology involves the contemplation of things which are enlarging and ennobling, in a spiritual sense. No education which leaves out training of the imagination is properly enlarging or ennobling; and where, outside of science, is there such opportunity for developing and training the imagination, and where in science, a better field than geology? The time-conceptions involved, the force-conceptions involved, the results involved in the operation of time and force, are among the greatest with which the student has to deal. They strengthen the mind by exercise of a sort which few other subjects afford. In space conceptions, astronomy surpasses it; in their appropriate spheres, physics and chemistry are equally effective for the educational ends here emphasized; but on the whole, no science surpasses it.

No subject affords a better field for the development of that sort of attitude of mind which seems especially to fit men for life. While there are phases of the subject which deal with facts and principles which lead to inevitable conclusions as certainly as mathematical reasoning does, there are other phases in which reasoning of another sort is called for. In most of the affairs of life, decisions are based on a preponderance of evidence. In few momentous decisions is the evidence so clear that there is but one side to the question. Rarely is the evidence 100:0; it is 75:25, or 60:40, or 51:49. And training in weighing evidence which is not overwhelmingly one-sided is one of the most important functions of education, for most of the

important decisions of life are reached by the balancing of conflicting evidence. Thorough training in geology must lead to the balancing of seemingly conflicting evidence, for there are multitudes of questions to which the student of even the elements of the subject is introduced, concerning which evidence must be weighed, and a tentative decision reached, with a full recognition of its tentative character. The recognition of this character of a conclusion opens the way to a revision of judgment when additional facts warrant, and this attitude of mind is the attitude to which good education should lead in connection with all questions where evidence is inconclusive, and this means in connection with many of the affairs of life.

No claim is set up that no other subject does the same thing. As a matter of fact, some do and some do not; but the claim is set up that the type of subject which works on strictly mathematical lines can not, by itself, afford the best preparations for the solution of the average problems of the average man. Neither can other types of subjects which do not involve the balancing of evidence, and the development of the power to separate what is weighty and relevant, from that which is light and irrelevant.

We progress from the uncertain to the certain. There are numerous problems in geology which were unsettled a generation ago, which have been solved now. There are many open questions now, which await solution. No subject better than geology gives training in the methods by which uncertainties are cleared up, by which stimulating but unverified hypotheses are tested, and advanced or rejected, as the case may be.

One of the great lessons which the world needs most to learn is that progress comes from cumulative achievement. If every individual could be made to realize that even his tiny contribution to the sum of useful work is really moving the world along, it would add grandeur to life and dignity to all human endeavor. This is a frame of mind that should be developed in every young person, and cultivated till it becomes a habit. Where can this be done better than in connection with such a subject as geology, where the stupendous results of processes which, day by day, seem insignificant, are constantly under consideration. Nowhere else in the whole range of subjects in our ken is the majesty of the cumulative results of seemingly slight processes more sharply emphasized and more constantly reiterated.

Processes are at work on the land which, by themselves, would in time destroy it utterly. They have been in operation so long that they would have accomplished this result eons ago, if nature had not provided counter-activities which defeat this end. Nowhere is the inter-play of constructive and destructive forces, using these terms in their bearing on man's life and welfare, more pointedly studied.

Dr. J. M. Clarke pointed out years ago that the study of paleontology afforded the basis for much of the philosophy of modern life. Professor Chamberlain has taken the general position that the study of ancient life is the proper starting point for the study of sociology. Unquestionably these men are right, at least in the claim that some of the principles which have been worked out laboriously in connection with modern human life, are well illustrated by the history of organisms long since extinct. It is perhaps too much to expect the sociologist to become a paleontologist first. Probably there is no more reason why he should, than why a man who wishes to use the English language well, should first become a Latin scholar. But it is

quite possible for the sociologist to lay hold of the principles which paleontology illustrates, if paleontologists will but put them into form available for application outside the field of fossils, just as it is possible for the student of the English language to lay hold of that which is vital for his purposes in the Latin language, by short-cut methods. Analogies between the courses of events in the history of Cambrian life, and the course of human events in modern times are interesting if not instructive, and they are doubtless more numerous and more pointed than the superficial student suspects.

One of the chief functions of education is to put man into sympathetic and appreciative touch with his surroundings. His physical surroundings are an important part of his environment, always and every where, and he who does not understand, is cut off from one of the great resources of life. It is of course true that one may enjoy a landscape, even if he does not understand geology; but he will enjoy it more if he does. A man may enjoy pictures and music without understanding much about them, but he will enjoy them more if he understands. And just as some education in music and art is to be desired because it increases a man's capacity for enjoyment of the things which he sees or hears occasionally, so education with reference to the landscape, which the average man sees much more than he sees works of art, and much oftener than he hears music, is a desideratum. To go about the earth blindly, unintelligent as to the meaning of its surface configuration, is to cut off one of the great pleasures of life, and especially one of the great pleasures of travel.

Since all men are in touch with at least a limited part of the land surface, and most of them in touch with enough of it to find lasting enjoyment in it if they are taught to see what it means, is it not reasonable to conclude that the subject which teaches them to see understandingly, is one which it must be profitable to pursue? How can we justify ourselves, if we withhold this resource from this and coming generations?

Prompted by the attitude of mind which mountains inspire, I have repeatedly watched their effect on groups of students who, for the first time, live in them long enough to have their influence felt; and I have seen, or thought I saw, how littlenesses and meannesses drop away, and how the nobler qualities come to the fore. John Muir has made much of this idea in one connection and another, and I think he is entirely right. To many men. mountains are as inspiring, as uplifting, as soul-stirring, as great essays or great poems are to others. Is it not just as great a mistake to leave the one out of consideration as the other? To the average young *man* at least, I suspect that mountains are quite as much of an intellectual and moral tonic as the best that he finds on the printed page.

What has been said of the mountains might be said, with modifications, of other parts of the earth. If there are those who think the landscape of an unrelieved tract like that about Chicago unlovely, I think this feeling would be changed completely if the grand march of events which has made that surface what it is, were understood. While it can never have the charm to the eye that some other sort of surface has, it has its own elements of attractiveness, its own beauty, to the eye which really sees. When men belittle the attractions of the level prairie, they advertise their ignorance. One may not chose to see the flat land all the time, any more than one would choose to read poetry all the time. With equal education in the two, I am confident that the normal man could live contentedly

with the plains longer than with poetry—even of the best.

The sea has a charm for almost every soul, but he who gets only what the eye records of color and movement, fails of the larger meaning, which, to beauty, adds grandeur. What does the salt of the sea mean? What is the period of time of its accumulation? What volumes of rock—many times all that is now above its surface—have been destroyed in its production? What range and volume of life, of which the voyager has but a glimpse, does it harbor now? What of the life of which it has been the home in the time which has passed since life was, and what of the great evolutions that have taken place within it? And what is yet to come? The great panorama of events, of processes, of changes, all of which are involved in the history of the sea, add a meaning larger than the eye, unaided, sees. To see the ocean merely as it is is like seeing the social fabric of to-day, without reference to what has been in the past, or what is to be in the future.

Our period of schooling is all too short to give us an intelligent look into all the fields with which it would be profitable to have acquaintance; but is this field on which we live and move and have our being, one we can afford to neglect?

From a wholly different point of view, geology is a valuable study. There is no subject in the curriculum which, rightly developed, can be made to lead more surely to correct methods and processes of reasoning. I remember that a former president of the Geological Society of America said, in his annual address, that the first courses in geology must be pouring-in processes, and that only later can anything be drawn out. In a sense this is of course true; but in another sense this doctrine is at the root of all that is worst in education. Geology, better than most subjects, can be taught from the beginning by the problem method. Given certain specific data—and the data may be in strict conformity to the facts of geology—the student can work out for himself the results which must follow. By this method, skillfully carried out, any man with ordinary intelligence for the comprehension of cause and effect can be let into the heart of the science with a minimum of information poured in, and that minimum bit by bit for use in the solution of problems. This method of instruction educates, but does not stuff him. The lecture method of instruction in the elements of geology, when well done, is hardly more than a stuffing process; when badly done, it is much less. In any case, it leaves the student relatively helpless in dealing independently with the reasons which give facts this meaning.

No subject within my ken lends itself better to this method of problem study than geology. In its simpler aspects, it deals with facts with which the student has some familiarity, and he can be led to reason from the known to that of which he has not thought, so that the work is, for him, original research from the outset. This is ideal education, and for this sort of education, geology is almost an ideal subject. We have heard much of discipline in education. This is the sort of discipline which counts.

There is much in the history of the science which is illustrative of the history of intellectual progress. It is not so long ago that one man's guess was about as good as another's, concerning anything that had to do with earth phenomena, and it was long years after facts began to be observed, before the convincing worth of facts was generally recognized. The history of the attitude of men toward fossils is typical of their attitude toward the science as a

whole, and is interesting, if not instructive. Though some part of the meaning of fossils was sensed by Xenophanes in the sixth century B.C., his views were soon lost, and did not reappear until the fifteenth century, when Leonardo da Vinci reaffirmed their genuineness, combating both the idea that they were accidents in the rocks, and the idea that they were introduced for purposes of deception. It is a curious fact that it was the defenders of the faith, who by their professions might appropriately have been the most valiant defenders of the integrity of all that the Creator had made, who, to prop up certain beliefs which they feared were in danger, ascribed to the Creator ignoble motives in introducing the fossils into the rocks.

Once the integrity of fossils was accepted, the conception that they were proofs of the biblical deluge had still to be reckoned with, and it was not until recent times that paleontological knowledge became so ample that *speculation* as to the meaning of fossils gave place to the noble conceptions which now obtain concerning their interpretation. The history of the subject is one of the best illustrations in all the realm of knowledge, of the potency of facts, and of the futility of generalizations without facts, and at the same time one of the best illustrations of the folly of bolstering up a lost cause by specious and ignoble arguments or affirmations.

The enlightening doctrine of organic evolution, which has perhaps done more than almost any other single doctrine to put the progress of the world on a safe track, would not have made the rapid progress it has in the last half century or so, had not the facts of geology given their powerful aid. Nowhere else can the general principles of biological evolution find more convincing support, and nowhere else can the wide application of the doctrine through long successions of ages, find unequivocal illustration. Geology therefore is one of the foundation stones of the doctrine which perhaps has done more than any other to develop the modern spirit of progress and research.

Probably no subject did more than geology to set intellectual attitudes to rights, after the baneful sway of medieval scholasticism. It became necessary in the end to deny facts or to abandon cherished beliefs, and in the long run there could be no doubt of the outcome. There can be no doubt that the temporary denial of facts and their obvious meaning was due to the fear of their consequences on current beliefs and doctrines which rested on feeble foundations. Denial was the last resort of the attitude of mind which found itself cornered, and it ended, as this sort of defense always ends, in making the defender ridiculous.

When Section E was organized under the name Geology and Geography, the conception of geography was somewhat different from that of the present day. I take it that the geography of that time was akin to what is now called physical geography; and to many, physical geography still is geography. This science, especially under the name of physiography, has attained an important place in modern education, more in colleges than in schools of lower rank, chiefly because the subject is in more competent hands in the former. Physiography is the surface expression of geology, the expression of the geology of our own times. As such, it is the phase of geology which most directly appeals to many men, the phase which puts him most readily into possession of the information which gives a meaning to the landscape. It was altogether fitting that this phase of geology

should be associated with geology in a section of this association.

But a new science of geography is growing up, almost unknown to those who are not concerned directly with its development. It is perhaps not yet very sharply defined, even to those who know it best, and hardly defined at all to others. It is clear that it is to center about the influences of earth features and earth resources on the distribution, character, and activities of life—life of all kinds. To what proportions this subject may develop, and how sharply its limits will be set, is not yet clear; but it is making giant strides where conditions for its development are favorable. It is actuated by the high motives of all science, one of which is the desire for truth for its own sake; but even more it is actuated by the desire to render its truth serviceable to mankind. Its field overlaps, in varying degrees, the fields of geology, physical geography, meteorology, botany, zoology, history, economics, and perhaps other sciences. But it uses the facts and principles of these sciences in explanation of the distribution, character and activities of life. The physical foundation for this new science of geography is geology, using that term as we should, to include all the earth, not merely the lithosphere. Whether this new science will belong properly in the same section of this association as geology, is an open question. Some phases of it do not find their closest relationships here, while others do. The subject as now conceived by those who are its leaders touches the life and welfare of the human race as intimately and as fundamentally as any other science.

There is one other aspect of both geology and geography, which gives them great educational value. Neither science is completed or nearing completion. There are great things ahead in both. As an organized science, geology is older than geography, at least older than geography in its modern sense, and is the more advanced. While geology has made phenomenal advances in the last half century, the problems ahead are so numerous and so interesting that even an elementary course in the subject, properly developed, opens up great vistas for the future. I believe it to be fundamentally important that young people should be led to see visions, and be inspired by the allurements of future development. Nothing is more conducive to a right attitude toward life in general, than the feeling of the possibility of participation in the progress of the future. In this, geology is not peculiar. Only as it is less advanced than some other sciences has it the advantage over them in this respect. In saying this, I am not losing sight of the fact that but few of those who give attention to geology in their student days will ever go farther; but a comprehension of what is likely to come stimulates an abiding interest, and abiding interest in various lines of work and thought are important elements in a good education.

In modern geography the promise is perhaps even greater, since less has been accomplished. Perhaps no science touches human life and interests more closely, or in more ways. There is, I am confident, no science which, properly developed and utilized educationally, will do more for the development of good citizenship. Its substance perhaps touches the essence of material life, especially on the human side, more intimately than any other science. No other science and no other subject, unless it be sociology and possibly modern history, is likely to do so much to promote sympathetic understanding between the nations of the earth, and this is one of the greatest desiderata not only of this day and generation, but of all days and genera-

tions. For this reason, if for no other, promulgation of the knowledge of modern geography should be furthered wherever possible.

When geography and geology, and subjects which have similar advantages, occupy larger places than they now do in our educational system, I believe that our young men and women will be better equipped than they are now to do their part in transforming a contentious world into a world of righteousness, based on mutual consideration.

ROLLIN D. SALISBURY
UNIVERSITY OF CHICAGO

THE REPORT OF THE COMMITTEE TO VISIT THE HARVARD COLLEGE OBSERVATORY

TO THE BOARD OF OVERSEERS OF HARVARD COLLEGE: The committee which you appointed to visit the astronomical observatory begs leave to submit the following report.

Both individually and as a committee we have kept in touch with the work of the observatory, visiting it from time to time and receiving statements from the director as to the condition and progress of the work.

Your committee finds the many researches going on in a most efficient and satisfactory way, and the results are published from time to time in bulletins and in the *Harvard Annals* which now number eighty volumes. The large amount and the high quality of the scientific output keeps the observatory in the position it has occupied for many years as one of the greatest observatories of the world.

In recent reports to you we have given in some detail the results of various special lines of investigation which the observatory has undertaken. In this report we desire to touch on the efforts of Professor Pickering to coordinate the general progress of astronomical science and to bring about a larger cooperation among the different observatories of the world.

One of the objects of the Harvard Observatory as stated in its statutes is "in general to promote the progress of knowledge in astronomical and kindred sciences." This, Professor Pickering has interpreted in the largest and most unselfish sense by laboring to advance the science in any and all ways, whether the particular credit for the work should come to the Harvard Observatory or not. As the object of the study was the same over-arching sky he has always believed that the most successful prosecution of the work would come from the fullest cooperation of those devoting their talents to the common aim.

Modern astronomy has demanded the most extended effort and the greatest concentration of resources extended over many years to produce the large amount of work which lies at the foundation of the astronomy of to-day. These investigations have demanded labors which no individual or institution could produce but have required the combined efforts of great observatories extending over many years.

In addition to this the best results are only obtained by division of labor and a condition where the special man and the particular problem are brought together. The science has now become so diversified that no astronomer has the versatility or the interest to carry on all the required branches of investigation. There is the problem of finance and the man; there is the problem of producing astronomical instruments as well as the man to use them; of taking photographs as well as measuring them; and, finally, the problem of estimating values and drawing reasonable conclusions from all the previous work.

In short, the progress of astronomy, like the advancement of civilization, requires many and diverse talents. It was the early realization of this truth which made Professor Pickering a pioneer in an unselfish policy to secure cooperation among astronomers so that each might be enabled to carry on the particular lines of work for which he is was best fitted.

As early as 1877 he published a pamphlet on "The Endowment of Research" and advocated a closer cooperation looking to the larger interests of the science.

In 1886, a second paper was published asking for an endowment of one hundred thou-

sand dollars, the income of which should be used to aid astronomers in existing observatories to work out their special problems.

In 1890, Miss Catherine Bruce, inspired by this idea, gave six thousand dollars to be distributed in whatever way promised the greatest scientific return. Eighty-six applications were received, showing the great need that was felt by astronomers for just this sort of aid. Fifteen grants were made to men of eight different countries. Among those thus aided we find the well-known names of Adams, Gill, Newcomb, Rowland and Turner. Appropriations were also made to international associations of astronomy and geodesy. It was through this gift that the true explanation of the variations in latitude was discovered, which was in itself a complete justification of the plan.

In 1903, Professor Pickering published a pamphlet showing the valuable results which might be expected by greater cooperation among observatories. He said we find "a great observer but no telescope, a great telescope but no astronomer to use it, and an astronomer whose valuable observations, the results of many long years of hard work, were rendered useless by the lack of a few hundred dollars to publish them." He showed how the appropriation of small sums would add greatly to the scientific output and advocated a sort of astronomical clearing house which would coordinate and support the best good of the science. But the results showed that the time was not ripe for such a forward step, for two leading astronomers declined to serve even on an informal advisory committee. A circular at this time was issued asking astronomers to state the needs of their work. Over one hundred replies were received and gave the best and most complete information ever collected on the subject.

In 1904, the director issued another paper to meet the adverse criticism which the project had aroused. Though the ideas of Professor Pickering were not entirely realized, the plan had the effect of improving the relations between astronomers, and eventually a very large degree of cooperation was realized.

In 1906, an address on "An International Telescope for Southern Latitudes" was given before the American Philosophical Society and the plan received serious consideration by a man of means.

In Science, 41: 82, Professor Pickering issued a questionnaire to twelve leading American astronomers asking them how they would use five thousand dollars if it were given them for research work. As a result of the replies it was found possible, through gifts and grants from existing research funds, to provide for a large part of these needs.

Probably the director of no observatory of the world has done so much for the cooperative ideal in astronomy nor has shown more unselfishness in the practical work of cooperation than Professor Pickering. Instead of trying to build up Harvard Observatory as a separate institution exclusively, he has had deeply at heart the advancement of the science regardless of who should receive the personal credit for the discoveries.

At the present time a large amount of work is carried on in cooperation with other institutions. One of the best illustrations of the value of this method is the determination of positions of the moon by the united efforts of Princeton, Yale and Harvard. Each observatory has carried on the part of the work for which it was best fitted, and which the others practically would have been unable to accomplish. The combined research has resulted in photographic positions of the moon which are, on the whole, the best so far obtained.

The most extensive cooperation in astronomical investigation is the Astrographic Catalogue and International Chart of the Sky. In this great work, now well advanced, the determination of stellar magnitudes was assigned to Harvard, and a large part of the work has now been completed.

By cooperation with the Mount Wilson, Lick and Yerkes Observatories the work has been extended to the faintest stars which now appear on photographic plates.

At present the observatory is determining the standard for the magnitudes of Professor Kapteyn's "Selected Areas." The work is

complete for the northern stars. Professor Kapteyn has thus determined the magnitude of about seventy thousand stars, which are now in print in *Harvard Annals*, Vol. 85.

Professor Pickering has also shown great interest in developing useful work among amateur astronomers. It is through him that the chairman of the visiting committee has been able to do some work on the asteroids. Through lack of expert direction a large part of the efforts of amateurs has proved of little value. An exception to this rule has been the Association of Variable Star Observers, which was formed five years ago and has received much encouragement and help from the director.

During the last year this association of enthusiastic amateurs, consisting of thirty observers, has made eleven thousand two hundred and fifty-two valuable observations of two hundred and ninety variable stars of long period. For this work the observatory has furnished suitable charts and determined the magnitudes of nearly five thousand stars needed for reference, so that all are now measured on the same scale. At a meeting of the Association of Variable Star Observers held at the observatory in November, 1916, nineteen skilled observers made estimates of the magnitude of the same object with the twelve-inch telescope which showed an average difference of less than one-tenth of a magnitude—an experiment altogether unprecedented.

As these observers generally have access to only small telescopes and are therefore unable to measure variables when they are faint, Professor Wilson and Professor Mitchel have shown their spirit of cooperation by kindly agreeing to continue the work with their sixteen-inch and twenty-six-inch telescopes when the stars are too faint to be measured by smaller instruments.

Also it should be mentioned that the observatory is cooperating with the other observatories of the world by furnishing magnitudes and classes of spectra in advance of their regular publication in the *Harvard Annals*, which has been spoken of in previous reports.

These are some of the facts which show the large way in which the observatory of Harvard is interpreting its work, and give some idea of how much Professor Pickering has done to encourage friendly scientific cooperation both here and abroad.

The fruits of much of this work will mature only in the future.

Some of this cooperation the war has temporarily broken but we look to the speedy re-establishment of it when this world calamity be overpast, and it will help to bind up the wounds and soften the animosities which now divide the nations.

The publishing of astronomical discoveries has not entirely ceased even now, and when peace is at last declared the common interest in the heavens will assert itself and bind together those whom the war has separated and estranged. Thus the cooperative study of astronomy will help to give us a new heaven through the interpretation of a nobler science and, through the good will which cooperation aways brings, a new earth, in which dwelleth righteousness.

Joel H. Metcalf, *Chairman*,
George R. Agassiz,
George I. Alden,
Ingersoll Bowditch,
Charles R. Cross,
Samuel W. McCall,
Herbert Parker,
Frederick Slocum,
Elihu Thomson

SCIENTIFIC EVENTS

THE MUSEUM OF THE UNIVERSITY OF PENNSYLVANIA

At the close of its free public lecture season the officials of the University Museum call attention to the recent progress of the institution and to some facts in connection with its activities.

Although only in its twenty-third year the University Museum is already recognized everywhere as one of the most important institutions of its kind in the world. Some of its collections are the finest in existence, its expeditions have gone to all parts of the globe,

bringing back rare specimens, while from an educational point of view it has done more than any other museum in revealing the early history of Mesopotamia and throwing light on early culture.

In spite of its youth the real estate, buildings and exhibits are given the very conservative valuation of more than four million dollars, or nearly the value of the total equipment of the entire university as carried on its books when founded.

Its collections of Chinese art are the largest and most representative to be found anywhere in the world, including China.

Its Babylonian collections are the most important in the world and scholars have used them to reveal millenniums of previously unknown history. The museum has published many of its translations, which have made a great impression upon the entire world.

Its Egyptian collections are very large and representative, and when those now held in Egypt until the war ends arrive, the exhibit will be one of the most notable in this country.

Its collections of Eskimo material are the most complete to be found anywhere, and it has a great collection of North American Indian specimens.

Its South American collections, especially those gathered by Dr. Farabee, are not only unrivaled, but the archeological exhibits are the greatest and are almost unique.

Its collections of Tibetan, Indian, Persian and Syrian art are large and valuable.

It has vast stores of valuable art and ethnological material stored away which there is no room now to place on exhibition.

How greatly the museum is appreciated outside this city is shown by the fact that within thirty days $75,000 has been given to the institution by men who have not even visited it, but who know of its value. Of this sum $30,000 has just been given by a New York man, who has watched its career with interest and approval, and has no connection whatever with the university, but desires to increase the museum's educational influences, and, approximately, $35,000 by another benefactor, also a non-resident of the state of Pennsylvania.

The museum is preparing to enlarge its sphere of public usefulness and will shortly issue an announcement of its purposes. It has done much by giving free public lectures Saturday afternoons by the best specialists, has given Wednesday afternoon lectures especially for school children and now desires in the most practical way to further cooperate with all art schools, art clubs, school art leagues and high-school art classes not only in this city but in the entire surrounding country. Already much work has been done by assisting manufacturers who have sought collections in the museum for securing new designs or new ideas, and it proposes to extend this work so far as is possible so as to bring the practical results of the exhibits in touch with the commercial expansion of the city to a greater extent than ever.

RECONSTRUCTION COMMISSIONS OF THE BRITISH GOVERNMENT

The British ministry of reconstruction has just published a complete list of the various commissions and committees that have been set up, both within that ministry and within other ministries and departments of the British government, to deal with questions which will arise at the close of the war.

These commissions and committees, which have been appointed at different times since the war began, now number 87 and fall into 15 groups.

Among the committees on scientific and industrial research are the following:

Fuel Research Board.—To investigate the nature, preparation and utilization of fuel of all kinds, both in the laboratory and, where necessary, on an industrial scale.

Cold Storage Research Board.—Appointed to organize and control research into problems of the preservation of food products by cold storage and otherwise.

Standing Committees on Engineering, Metallurgy, Mining and Glass and Optical Instruments.—To advise the council on researches relating to the lines of activity named and on such matters as may be referred to the committee by the advisory council.

Joint Standing Committee on Illuminating Engineering.—To survey the field for research on il-

lumination and illuminating engineering, and to advise as to the directions in which research can be undertaken with advantage.

Mine-rescue Apparatus Research Committee.—To inquire into the types of breathing apparatus used in coal mines, and by experiment to determine the advantages, limitations and defects of the several types of apparatus, what improvements in them are possible, and whether it is advisable that the types used in mines should be standardized, and to collect evidence bearing on these points.

Abrasives and Polishing Powders Research Committee.—(1) To conduct investigations on abrasives and polishing powders with a view to their preparation and use as one factor in accelerating the output of lenses and prisms for optical instruments, not only for peace requirements but in connection with the war. (2) To investigate the preparation and properties of abrasives and polishing powders.

Food-research Committee.—To direct research on problems in the cooking of vegetables and meat, and in bread making, to be undertaken by two scholars of the committee of council.

Building-materials Research Committee.—To make arrangements for carrying out researches on building construction instituted by the department at the instance of the local government board committee or otherwise, to be responsible under the council for the direction of such researches, and to deal with such other matters as may be referred to the committee from time to time by the council.

Electrical Research Committee.—A committee of direction appointed in connection with certain researches affecting the electrical industry.

Committee for Research on Vitreous Compounds and Cements for Lenses and Prisms.—To conduct researches into the preparation, properties and mode of employment of cements for lenses and prisms; to prepare a reference list of vitreous compounds, their composition, densities, refractive indices and dispersive powers.

Tin and Tungsten Research Board.—The Cornish Chamber of Mines has been invited to nominate a representative of the landlords and a representative of the mine owners to serve on the board. A committee of control appointed in connection with certain researches into tin and tungsten.

Lubricants and Lubrication Inquiry Committee.—To prepare a memorandum on the field for research on lubricants and lubrication, which will contain an analysis of the problems involved, together with a suggested scheme of research, which would be most likely to lead to valuable results.

Provisional Committee on Research and Education for the Cotton Industry.—A committee appointed with a view to the organization of a research association for the cotton industry.

Provisional Committee on Research for the Wool and Worsted Industries.—A committee appointed with a view to the organization of a research association for the wool and worsted industries.

Provisional Committee for the Internal Combustion Engine Industry.—A committee appointed with a view to the organization of a research association for the internal combustion engine industry.

MEETING OF THE GENERAL MEDICAL BOARD OF THE COUNCIL OF NATIONAL DEFENSE

DEDICATION of the Warden McLean Auditorium at Camp Greenleaf, the military medical school at Camp Chickamauga, Ga., on March 11 was made notable not only because of the presence of the Surgeon General of the Army and members of his staff, as well as many distinguished medical men from military and civil life, but also because of the regular meeting there March 10 of the General Medical Board of the Council of National Defense, usually held in Washington. About 1,000 doctors, who as medical reserve officers are taking the three months' course, accepted the invitation to attend extended by Dr. Franklin Martin, member of the advisory commission of the council and chairman of the board.

These members of the General Medical Board attended: Dr. Franklin Martin, chairman; Dr. William F. Snow, secretary; Surgeon General William C. Gorgas, Dr. Victor C. Vaughan, Dr. William H. Welch, Dr. John Young Brown, Dr. John G. Clark, Dr. Thomas S. Cullen, Dr. Edward P. Davis, Dr. William D. Haggard, Dr. Jabez Jackson, Dr. Edward Martin, Dr. Charles H. Mayo, Dr. Stuart McGuire, Dr. John D. McLean, Dr. Hubert A. Royster.

Introduced by Dr. Martin, Surgeon General Gorgas said he knew of no more important work than the activities being developed at Camp Greenleaf; that the necessity of military medical training is obvious; also that on a visit to England five years ago he learned that the great developments in the English

system had been forced by the necessities arising during the Boer War; so, he said, the United States Military Medical Service is being developed by the exigencies now confronting us and would continue after the war. He said he gained from the British service ideas of value for his administration.

Dr. William H. Welch read a statement showing that in February there was an exceedingly satisfactory decline in the admission rates for communicable diseases, as well as for all causes. In the force afloat, the situation as to pneumonia and cerebrospinal fever is very satisfactory. Scarlet fever has been slightly more prevalent than usual but in no sense epidemic; a very satisfactory decrease in measles; mumps continues as heretofore.

For the committee on surgery, Dr. Charles H. Mayo told how data on 21,000 physicians had been gathered and placed on cards convenient for the ready selection of individuals and groups suited for any given task, a duplicate set of which cards has been prepared for the use of the Surgeon General's office in France. Dr. Mayo emphasized the need of reconstructing wounded men, not only for field service but also for labor after the war, inasmuch as the usual tide of immigration has ceased. Citing the many government activities in which medicine enters, he said these relations, he believed, could be coordinated in no way except by having a medical man as a Cabinet officer.

Lieutenant Colonel Victor C. Vaughan, reporting for the committee on legislation, told of the request of the Army medical officers for higher rank and greater authority, and of the Owen-Dyer bill (S. 3748 and H. R. 9563) now pending in Congress. He cited instances which he said indicated need for greater rank, and then read the following letter from President Wilson to Dr. Franklin Martin, indorsing the bill:

> I read very carefully your memorandum of February 27 about the rank accorded members of the Medical Corps of the Army, and have taken pleasure in writing letters to the chairman of the Military Committees of the House and Senate, expressing the hope that the bill and resolution may be passed.

LECTURES ON AGRICULTURE

It has been arranged that a group of prominent agricultural speakers shall travel through the northern and western states, after conferences in Washington with Secretary of Agriculture Houston and Food Administrator Hoover to impress on the farmers the necessity of producing large crops during the coming season. A similar campaign already has been conducted in the southern states. The following have consented to take part in the campaign:

Dr. W. O. Thompson, president Ohio State University, speaking in Idaho and Wyoming.

Alva Agee, secretary of the New Jersey board of agriculture, speaking in Ohio.

Dr. A. H. Jordan, director of the New York Agricultural Experiment Station, Geneva, N. Y., speaking in Pennsylvania and Connecticut.

Dr. J. L. Hills, dean of the College of Agriculture, University of Vermont, speaking in New Hampshire.

Dr. C. F. Curtiss, director of the Iowa Agricultural Experiment Station and dean of the Iowa Agricultural College, speaking in Kansas and Nebraska.

Dr. Eugene Davenport, dean of the College of Agriculture, University of Illinois, speaking in Wisconsin.

Dr. W. J. Kerr, president of the Oregon Agricultural College, speaking in Oregon and in Idaho.

Professor William M. Jardine, president of the Kansas Agricultural College, speaking in Missouri.

Dr. C. A. Lory, president of the Colorado Agricultural College, speaking in Colorado.

Dr. S. C. Mitchell, president of Delaware College, speaking in New Jersey and Rhode Island.

Dr. E. C. Perisho, president of the South Dakota Agricultural College, speaking in South Dakota and Montana.

A. J. Glover, editor of Hoard's Dairyman, speaking in Minnesota.

Dean Alfred Vivian, of the College of Agriculture, Ohio State University, speaking in Iowa.

Dr. T. F. Hunt, dean of the College of Agriculture, University of California, will go direct from California for speeches in the state of Washington early in April.

SCIENTIFIC NOTES AND NEWS

The annual meeting of the National Academy of Sciences will be held at the Smithson-

ian Institution in Washington on April 22, 23 and 24. The program includes accounts of war activities in different branches of science and reports of the results of several important scientific researches by members of the academy and others. The Hale lectures will be given by Professor John C. Merriam, of the University of California. His subject is "The beginnings of human history from the geologic records."

PROFESSOR COMFORT A. ADAMS, of Harvard University and the Massachusetts Institute of Technology, is the nominee of the directors of the American Institute of Electrical Engineers for president for the year beginning August 1.

SURGEON-GENERAL SIR ALFRED KEOGH, G.C.B., has been appointed to the Order of the Companions of Honor for services in connection with the war.

DR. BENJAMIN F. ROYER, Harrisburg, acting commissioner of health of Pennsylvania, will deliver the memorial address on the late commissioner, Dr. Samuel G. Dixon, at the Academy of Natural Sciences, Philadelphia, on April 9.

DR. H. L. RUSSELL, dean of the college of agriculture of the University of Wisconsin, has been appointed by the Food Administration to take charge of the division of butter and cheese, in succession to Mr. George E. Haskill.

PROFESSOR CLARENCE A. WALDO, Ph.D., late of Washington University, St. Louis, Mo., retired last commencement from the Thayer professorship of mathematics and applied mechanics, as professor emeritus and is now living at 401 West 118th St., New York City.

JAMES ZETEK, professor of biology and hygiene at the Instituto Nacional de Panama, has been appointed entomologist of the Board of Health Laboratory, Ancon Hospital, Canal Zone.

DR. HARRY B. YOCOM, professor of zoology at Washburn College, has been commissioned first lieutenant in the Sanitary Corps and ordered to report for duty to Fort Sam Houston, San Antonio, Texas.

DR. JOHN W. KIMBALL, instructor in chemistry and physics at the dental school of Western Reserve University, has been called to Washington to undertake chemical work for the Army. Dr. Kimball has been granted leave of absence from the university and will leave immediately to take up his new work.

PROFESSOR ELMER P. KOHLER, of the department of chemistry of Harvard University, has gone to Washington and will give his whole time, at least until the beginning of the next academic year, to chemical research for the national government. He will be at the experiment station of the Bureau of Mines as assistant to the director in charge of research problems.

FRANCIS C. FRARY, research chemist of the Aluminum Company of America, has been commissioned as captain in the ordnance reserve corps and assigned to research work in the trench warfare section, Engineering Bureau office of the chief of ordnance, Washington, D. C.

JOHN G. FRAYNE, an instructor in physics at the University of Minnesota, has enlisted in the signal corps of the army and will be sent to France.

DR. B. FRANKLIN ROYER, who has been chief medical inspector of the Pennsylvania State Department of Health for a number of years and who has supervised the work in the Harrisburg office during the long illness of Dr. Samuel G. Dixon, has been appointed acting health chief, pending the selection of a permanent successor to the late commissioner.

DR. ROBERT A. LYSTER, lecturer in public health and forensic medicine at St. Bartholomew's Hospital, and county medical officer for Hampshire, has been elected editor of *Public Health*.

PROFESSOR FREDERIC J. CHESHIRE, director of the department of technical optics at the Imperial College of Science and Technology, has been reelected president of the Optical Society of Great Britain.

MR. CLYDE L. PATCH, of the Victoria Memorial Museum, Ottawa, lectured on "Local Snakes, Frogs and Salamanders: their relation to agriculture," on February 5, under the auspices of the Ottawa Field Naturalists Club.

He discussed twenty-five different species and described observations made in eastern Ontario. The lecture was illustrated with living specimens and lantern views.

Through the courtesy of the regents and secretary of the Smithsonian Institution, a reception was tendered there on the evening of February 28 by the Chemical Society of Washington to the five hundred chemists temporarily residing in Washington for war duty. Addresses of welcome were made by Dr. Frederick B. Power, president of the society, and by Dr. George P. Merrill, head curator of geology of the Smithsonian Institution, after which brief addresses were made by Professor Frank W. Clarke, Dr. Charles L. Parsons, Major Samuel J. M. Auld, the British chemist cooperating with this government in the Gas Defense Service, Chancellor Samuel Avery, of the University of Nebraska and Professor Wilder D. Bancroft. A large proportion of the guests were in uniform and included many of academic distinction.

G. A. Lebour, for many years professor of geology at the University of Durham, died on February 7, at the age of seventy-one years.

The death is announced of C. I. Istrati, professor of organic chemistry and dean at the University of Bucharest and president of the Roumanian Academy of Sciences.

Dr. A. W. E. Erlandsen, professor of hygiene at the University of Copenhagen, has died at the age of thirty-nine years.

Owing to greatly increased activities in the Public Health Service, there is urgent need of the services of medical officers for field duty in connection with the sanitation of numerous civil sanitary districts. The salaries of the positions in question vary from $1,800 to $2,500 per annum, depending on the qualifications and experience of the appointees. Men who have been disqualified physically for the Medical Reserve Corps are eligible for appointment, provided they are not suffering from complaints which will seriously interfere with the performance of their duties. It is especially desired to secure the services of competent sanitarians and those who have had previous experience in health work. There are also numerous vacancies for sanitary engineers, scientific assistants, sanitary inspectors and others. Applications for appointment to these vacancies should be made to the Surgeon-General, U. S. Public Health Service, Washington, D. C., and in order to avoid unnecessary correspondence should include complete data concerning age, nativity, experience and training, and other necessary information.

UNIVERSITY AND EDUCATIONAL NEWS

A gift of a large tract of land has been made to Harvard University by Mr. Andrew Carnegie, President A. Lawrence Lowell, Mr. Henry L. Higginson and ten others. The tract, which comprises 2,344,000 square feet, is adjacent to the Soldiers' Field. There are no buildings on the land, and, according to university authorities, no plans have been made for the immediate use of the property.

Gifts reported at the recent Corporation meeting of Yale University, included one of $5,000 from Mrs. James Wesley Cooper, of Hartford, for the establishment of a publication fund in memory of her husband, who graduated from the college in 1865 and who was for over thirty years a member of the corporation, and $5,000 in memory of the late William A. Read of New York by his widow, to assist the work of the Yale University Press. Two bequests were also announced: $10,000 from the late Samuel J. Elder, for the college, and $5,000 from the widow of Amory E. Rowland, for the benefit of the Sheffield Scientific School.

By the will of Mrs. Eliza C. Farnham $1,200 is left to the Howard College for two Horace Farnham Scholarships.

Assistant Professor Herbert L. Seward, '06 S., of the Sheffield Scientific School of Yale University has been granted leave of absence to become head of a new school being organized by the Navy Department to train engineers for the naval service. The leave of absence granted by the corporation begins on May 1, but Professor Seward will continue in charge of the engineering instruction of the

Yale Naval Training Unit for the rest of the year.

Dr. W. F. G. Swann has accepted a professorship in the department of physics at the University of Minnesota, the appointment to take effect on August 1, 1918.

DISCUSSION AND CORRESPONDENCE

SCOTT ON THE CANONS OF COMPARATIVE ANATOMY

In a recent number of this journal (N. S., Vol. XLVII., No. 1204) my esteemed friend, Dr. D. H. Scott, the distinguished foreign secretary of the Royal Society has published a review of my recent volume on "The Anatomy of Woody Plants." He objects, with delightful British vigor, to the Canons of Comparative Anatomy described in the seventeenth chapter. His criticisms, in fact, of the volume mainly involve these canons, which he regards as highly controversial and based on deductive evidence. Dr. Scott naturally has his own opinions on many anatomical subjects, and these are often different from my own. The question, however, as to whether the Canons of Comparative Anatomy are deductive or inductive appears to be not a matter of opinion but a matter of fact. Inductive reasoning, which is ordinarily defined as the drawing of general conclusions from particular facts, was brought into prominence nearly three hundred years ago by Sir Francis Bacon, an eminent Englishman. I must urge that the Doctrine of Conservative Organs is based on purely inductive reasoning. In accordance with that doctrine it is stated that root, leaf and reproductive axis retain ancestral anatomical features approximately in the order named. This is an induction from the facts that the reproductive axis of the Calamites and Equiseta, the reproductive axis and root of the Araucarian and Abietineous Conifers, the reproductive axis and root of *Ginkgo*, the reproductive axis and root of the higher Gnetales, all retain notable the features of organization of older or extinct allied forms. It appears to me that Dr. Scott confuses the origin of the Canons of Comparative Anatomy with their application. The Canons are derived inductively by the comparison of older with modern forms, and are employed deductively to elucidate the relations of modern forms among themselves.

The soundness of the general principles of the seventeenth chapter of my volume on anatomy has a very sincere and flattering testimony in the attitude of a small coterie of critics of the anatomical work of "Jeffrey and his school." These critics use the canons in every case, but if I may be forgiven a pun are unable to aim straight. The most recent instance of this defect is furnished by an article on the vessels of *Gnetum* in the January number of the *Botanical Gazette*. This author calls attention to the fact that vessels of the lower *Ephedra* type having end walls with many large open bordered pits are found in the root, reproductive axis, and seedling of *Gnetum*. He argues very properly from this that the *Gnetum* type of vessel has come from that found in *Ephedra* and persists in the conservative organs of the first-named genus. This conclusion is correct as far as it goes, but when the author states that the type of vessel found in *Gnetum* is different from that found in the Angiosperms he shows a surprising ignorance, since in DeBary's classic text-book of comparative anatomy published over forty years ago a number of cases of angiosperms with the *Gnetum* type of vessel terminated at either end by a single large-bordered pore have been cited. I might go on to enumerate a number of other equally sincere and flattering testimonials to the soundness of the Canons of Comparative Anatomy, although not to the accuracy of their utilizers, from recently published works. If imitation is the sincerest flattery, I am indeed flattered. A number of lines of work being carried on in my laboratory, and among these, notably an investigation on a large amount of material of Comanchean and Laramie Cretaceous Conifers, will, I think, add much strength to these generalizations.

A frank and friendly criticism such as Dr. Scott has written always helps to clear up differences of opinion by bringing forth clearer and more forcible statements from either side.

E. C. Jeffrey

THE JERUSALEM ARTICHOKE AS A WAR PLANT

In the March number of the *Scientific Monthly*, Professor T. D. A. Cockerell publishes an interesting article entitled "The Girasole, or Jerusalem Artichoke, a Neglected Source of Food." It will be interesting to add that the French Academy of Agriculture has by no means overlooked this important plant, the French name of which is *topinambour*. For the last two or three years the Comptes Rendus des Séances de l'Académie d'Agriculture has contained frequent references to the value of this crop, most of the communications having been made by M. Schribaux. In the last number, which comes to my desk today, M. Schribaux presents an interesting communication from M. Thiry, director of the Agricultural School of Tomblaine near Nancy. He says that in a normal year only about a hundred hectares are planted in Lorraine, but he believes that the plant is capable of rendering great services. In his own family they have regularly raised and eaten the *topinambour* since at least 1860. All of the agricultural land in Lorraine is not well adapted to its cultivation, only light lands being best adapted. In general, they feed the tubers to the horses, giving a little to the pigs, but never to the cattle, for they think that this diet gives the milk a bluish tinge. He states that the crop is more productive than potatoes, and they often raise at Tomblaine thirty thousand kilograms to the hectare. He uses the variety called *patate* by Vilmorin. It has more regular tubers, and while not less productive is more delicate than the ordinary variety. He has eaten them in his house for a long time, since he tasted Jerusalem artichokes in England, and he has fed them to the children of the refugees whom he has taken in. Last year the people of Nancy wished to eat them, since potatoes were out of their reach, but at that time they were beginning to germinate and were not edible. He thinks the plant is a very remarkable one, and that in fertile earth well worked it will repay the labor of the farmer with great interest. Whether the climate is severe or dry, and even when the earth is poor and weedy, the crop will still be satisfactory, and it lacks the diseases of the potato. He believes it to be *a war plant of the first order*. He thinks that a serious effort should be made to propagate this vegetable in all France.

L. O. Howard

Washington, D. C.

POISONING TREE PARASITES WITH CYANIDE OF POTASSIUM

Some three years ago there was discussion in this journal of the method of killing insect parasites of fruit trees by placing cyanide of potassium under the bark. Success was reported from such inoculation of peach trees. Others reported that cyanide of potassium mixed with other poisons, when used in the same manner, caused the death of the tree within two or three years.

Three years ago, in the spring, I bored half inch holes in each of six apple and pear trees and filling these holes with powdered cyanide of potassium, "chemically pure," plugged them up. Four of these trees were apparently dying from scale, the other two were infested but not dying. During the summer all six became free from scale and the four dying ones began to recuperate. In the fall both the apple and the pear trees bore good fruit which was palatable and harmless. All the trees are now healthy and vigorous after three years, and there are no areas of dead bark around the inoculation holes.

This seems an indication that inoculation with cyanide of potassium, when used without admixture of other drugs, is not necessarily injurious to apple and pear trees. Its effectiveness as a parasite exterminant is rendered doubtful, however, by the fact that the scale died on all my other trees which were not inoculated. One of these trees was practically dead at that time, having lost all but two of its branches, but it is now vigorous. I lost two good trees from scale before this. Scale had been becoming more and more troublesome in northern Ohio for a number of years, but three years ago many infested trees became entirely free or almost free from the pest, and in this whole region there was marked improvement in the orchards, which

are not yet back to their former bad condition.

Maynard M. Metcalf

The Orchard Laboratory,
Oberlin, Ohio

SYSTEMATISTS AND GENERAL BIOLOGISTS

May I endorse the suggestion by Dr. L. O. Howard?[1] He says that he does not know whether determination of species is important to the experimental embryologist. When, as zoological recorder for Echinoderma, it was my duty to read a large number of papers by those workers, I formed the opinion that it certainly was important, and wrote:[2]

> It is well to urge on those gentlemen the need for an accurate determination of the material with which they work. They are too much inclined to infer the universal from the particular, and to overlook the fact that species and even local races differ from one another in their reproduction and development, just as much as in their habits and perhaps more than in their structure.

This plea was strongly supported by Viguier.[3]

Accurate discrimination of species is no less necessary for the field naturalist. J. H. Fabre, always ready to gird at the museum worker, had to confess that he had confused under the one name *Eumenes pomiformis* three species of mason-wasps, so that it was not possible for him "to ascribe to each of them its respective nest" (I quote from the selection just published under the title "The Wonders of Instinct," London, Fisher Unwin).

Most geologists have by this time learned that, for lack of the precautions advocated by Dr. Howard, many of their fossil lists are not worth the paper they are printed on. Recent advances in stratigraphical geology are almost entirely due to the keener appreciation of minute specific differences.

In a word, every kind of biologist should find in the despised taxonomist a valuable, indeed an indispensable, ally; and in our museums he should recognize a depository where the evidence for his conclusions may be preserved for future generations of workers.

London F. A. Bather

[2] *Zool. Rec.*, for 1901.

[1] Science, January 25, p. 93.

[3] 1903. *Ann. Sci. Nat. Zool.*, ser. 8, Vol. 17, p. 71.

SCIENTIFIC BOOKS

Lectures on Heredity. By H. S. Jennings, Ph.D., LL.D., Johns Hopkins University; Oscar Riddle, Ph.D., Department of Experimental Evolution, Carnegie Institution; and W. E. Castle, Ph.D., Harvard University. Delivered under the auspices of the Washington Academy of Sciences, Washington, D. C. 1917. Pp. 82. Bound in buckram, 50 cents.

This is the second annual series of lectures presented before the Washington Academy of Sciences and reprinted in collected form from the *Journal* of that academy.

The study of genetics has become so highly specialized that workers in the different fields have ceased, except in rare instances, to make a serious effort to coordinate their work with that of others.

Dr. Jennings's classical work on the nature of variations in lower organisms deals with one of these highly specialized branches, and students of other branches should appreciate the service rendered by Dr. Jennings in his painstaking comparison.

"Having satisfied myself as to the nature of the variations that arise in the creatures that I have studied, I have looked about to see what other workers have found; and to determine whether any unified picture of the matter can be made."

After claiming that the idea of genotypes must be admitted as a general condition, the author concludes that this result "is not final, that it does not proceed to the end."

In a uniparental organism, from which all question of the recombination of existing diversities is eliminated, Dr. Jennings finds that "the immense majority of the hereditary variations were minute gradations. Variation is as continuous as can be detected."

The points at issue between the "genotypic mutationists" and the upholders of gradual change are clearly and concisely stated. Setting aside the question whether the evidence held to support the gradual change theory is conclusive or not, he proceeds directly into territory of the mutationists and shows that the "multiple allelomorphs" found in *Droso-*

phila supply in themselves all the evidence that even an extreme selectionist should ask. To explain why large changes are observed as well as small ones it is suggested that we may be "witnessing the disintegration of highly developed apparatus instead of its building up."

Dr. Castle's contribution also deals with the controversy over the nature of evolutionary change, whether continuous or discontinuous. He, however, is less inclined than Dr. Jennings to resolve the differences between the two schools into differences in the use of terms. After allowing for the effects of the confusion in terminology, he sees "two contrasted sets of ideas," which he arranges under the headings *Darwin* and *DeVries*.

Students of paleontology, geographical distribution and classification are shown, in general, to favor the belief in gradual evolution and the efficacy of selection. The opposite view, that of discontinuous variation and stability of new forms, is held by a majority of the students of experimental breeding. Support of the former view by one who has done such thorough work as an experimental breeder must have great weight.

From the point of view taken by Jennings, it would seem that in contrasting the mode of origin and the stability of new types Castle is himself open to the criticism of using the term "type" ambiguously. If by a new type is meant anything new, most geneticists would range themselves with DeVries, but if a new type is something more comprehensive, DeVries and his followers must stand alone.

The crux of the difference between Castle's views and those of practically all classes of mutationists would seem to be in Castle's holding that selection determines in some measure the range of variation in subsequent generations. Confining the question to inherited variations, does the selection of extreme variations form new centers of distribution? To do so, it would seem that small variations must be more numerous than large ones, an assumption which would be questioned by most mutationists, including Morgan.

Although cases were encountered in Dr. Castle's own work in which selection gave no tangible results, in many characters progress was rapid and continuous, with no indication of other than physical limits, and it is held that in the smaller mammals, which Dr. Castle has studied intensively for many years, there are few characters which can safely be referred to the agency of perfectly stable genes.

That selection does, from a practical standpoint at least, produce results is abundantly shown by Dr. Castle's work. If by the use of refined reasoning his critics are able to show that change in a single Mendelian character is not the only possible explanation of the results, these critics may then be referred to Jennings's results with *Difflugia*.

Dr. Riddle has here brought together in a concise and readable form the results of his extensive experiments on the nature of sex in pigeons and has coordinated these results with the work of other investigators.

Sexual differentiation is interpreted as the expression of quantitative differences in the rate of protoplasmic activity; the more active metabolism resulting in males, the less active in females. Many lines of evidence are presented, all of which are consistent with the view that preponderance of one or the other sex is conditioned by the rate or level of metabolism. These various lines of evidence show the following characteristics to be associated with the female sex, all of them being associated also with a low level of metabolism: Large size of yolk, low per cent. of water in the yolk, high per cent. of stored material, high total stored energy, exhausted physical condition of the mother, age of the mother.

In crosses the percentage of males increases with the width of the cross to the point of infertility. Since males are characterized by a more active metabolism, there is an agreement between these results and the commonly observed increased vigor of hybrids.

Assortive mating of gametes and differential death rates are fully considered and neither

is found to furnish a possible explanation of the controlled sex ratios.

Not only can the sex of pigeons be changed but it can also be accentuated. The females hatched from the second egg of the clutch, laid in the autumn by overworked birds, are more pronounced females than the normal females of the species. This is evidenced by the persistence of a right ovary in such birds. In normal female pigeons the right ovary has completely degenerated in the week-old squab.

The literature reviewed gives evidence of a relation between rate of metabolism and sex in a great variety of animals, varying from worms to man. With sex viewed as an expression of differentiated metabolic activity, its independent origin in diverse groups of organisms ceases to be a stumbling block, being no more remarkable than that the same color should have originated independently in different groups. The work reported is confined to the animal kingdom and it should be of interest to determine whether in diœcious plants there is a corresponding differentiation in the rate of metabolic change.

Dr. Riddle's work would seem to call for discussion by those students of genetics who place the distribution of the chromosome in a causal relation to sex, since his results directly challenge this interpretation. It is shown that in some cases at least sex is determined before the segregation of the chromosomes, a fact which would seem to make chromosome number a characteristic rather than a cause of sex.

Furthermore, the challenge extends to all Mendelians, for if "one hereditary character (sex) is modifiable, is of a fluid, quantitative, reversible nature," surely the alternative nature and stability of other characters come in question.

It is worthy of note that all three investigators, though working in widely separated fields and approaching the problem of evolution from very different angles, conclude that evolutionary change is, in effect at least, a gradual process that is not beyond the power of man to man influence.

G. N. Collins

SPECIAL ARTICLES

THE RÔLE OF CATALASE IN ACIDOSIS

If an inorganic acid, such as hydrochloric. be administered to an animal, it is neutralized by the alkalies of the blood and tissues; if an organic acid be administered, it is oxidized, unless the oxidative processes of the animal are defective, as in diabetes, in which case the organic acids are neutralized, as are the inorganic. This neutralization of acids leads to a depletion of the "alkaline reserves" of the body, which produces the condition known as acidosis. By the term acidosis is meant the impoverishment of the tissues and blood in alkalies. In very severe cases of diabetes, the animal is not able to burn sugar and can burn fat and protein only as far as β-oxybutyric and diacetic acids and acetone, hence the tissues of the diabetic would become acid in reaction were it not for the fact that the acids formed in this disease are neutralized by the alkalies of the tissues. Since this neutralization leads to a depletion of the "alkaline reserves" of the body in severe cases of diabetes and since acidity of the tissues is incompatible with life, the animal dies. From the foregoing it is readily understood how the intravenous infusions of sodium bicarbonate are helpful in overcoming the coma of diabetes. Besides diabetes, it is known that acidosis occurs in "surgical shock," in anesthesia, and in starvation. It is also known that in these conditions oxidation is decreased and that the accumulation of the resulting incompletely oxidized substances, acid in nature, are responsible for the acidosis. The present investigation was carried out in an attempt to find an explanation for the decreased oxidation with resulting acidosis in the conditions mentioned.

Diabetes.—Pancreatic diabetes was produced in dogs by extirpating the pancreas. Sugar appeared in the urine a few hours after the operations. About two weeks later, when the animals were in a moribund condition, they were killed and the blood vessels were washed free of blood by the use of large quantities of 0.9 per cent. sodium chloride, as was indicated

by the fact that the wash water gave no test for catalase. The tissues were then removed and ground up separately in a hashing machine. The catalase of one gram of the different tissues was determined by adding this amount of material to 50 c.c. of hydrogen peroxide in a bottle at 22° C., and as the oxygen gas was liberated, it was conducted to an inverted, graduated vessel, previously filled with water. After the oxygen gas thus collected in ten minutes had been reduced to standard atmospheric pressure, the resulting volume was taken as a measure of the amount of catalase in the gram of material. The material was shaken in a shaking machine at a fixed rate of 180 double shakes per minute during the determinations. It was found that the catalase of all the tissues of the diabetic dogs was decreased, the greatest decrease being in the heart and liver. The catalase of the heart was decreased by about 48 per cent. while that of the liver was decreased by about 72 per cent.

"*Surgical Shock.*"—The condition of shock" was produced in cats and dogs by handling and manipulating the intestines. It was found that as the blood pressure decreased and the condition of "shock" developed, there was an accompanying decrease in the catalase of the blood, and that when the condition of "shock" was fully developed as was indicated by a fall in blood pressure to approximately 30 mm. of mercury, the catalase had decreased about 40 per cent. from the normal. Henderson observed that oxidation was decreased in "surgical shock" with resulting acidosis. Cannon has shown that in man in conditions of traumatic shock there is a condition of acidosis which is relieved by injections of solutions of sodium bicarbonate.

Anesthesia.—The anesthetics used were ether, chloroform, chloral hydrate, nitrous oxide, and magnesium sulfate. The animals used were cats, dogs, and rabbits. The ether and chloroform were administered by bubbling air through the respective anesthetics in a bottle, which was connected by a rubber tube to a cone adjusted over the snout of the animal. Chloral hydrate anesthesia was produced by the introduction into the stomachs of rabbits of 10 c.c. of a 2 per cent. solution of chloral hydrate per kilo of body weight. A mixture of nitrous oxide and oxygen in the poportion of one to five was administered to cats in the production of nitrous oxide anesthesia, while magnesium sulfate anesthesia was produced by the subcutaneous injection of 7.5 c.c. of a 20 per cent. magnesium sulfate solution per kilo of body weight. It was found that the catalase of the blood was decreased by all of these anesthetics and that the extent of the decrease was proportional to the depth of anesthesia. Chloroform and nitrous oxide, in keeping with their rapid action as anesthetics, decreased the catalase of the blood very quickly, whereas chloral hydrate and magnesium sulfate, in keeping with their slower action, decreased the catalase much more slowly, while ether occupied an intermediate position in this respect. It is recognized that there is a decrease in oxidation with resulting acidosis in anesthesia and that this is more likely to occur with a powerful anesthetic, such as chloroform, than with ether.

Starvation.—Four rabbits were used in this experiment. Two of them were killed before the period of starvation was begun, and after washing the blood vessels free of blood, the catalase of the different tissues was determined according to the method described in this paper under "diabetes." The remaining two rabbits were starved for six days, and at the end of this time the catalase of the tissues was determined in the same manner as that of the unstarved rabbits. It was found that the catalase of the voluntary muscles was decreased during starvation by 40 per cent.; that of the fat by 70 per cent.; while it remained normally high in the heart.

The conclusion is drawn that the defective oxidation in diabetes and the decreased oxidation in anesthesia, starvation, and "surgical shock"with resulting acidosis is propably due to the decrease in catalase, an enzyme found in the tissues and possessing the property of liberating oxygen from hydrogen peroxide.

W. E. BURGE

PHYSIOLOGICAL LABORATORY OF THE
UNIVERSITY OF ILLINOIS

SCIENCE

FRIDAY, APRIL 12, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE CONTRIBUTION OF ZOOLOGY TO HUMAN WELFARE[1]

AT the Philadelphia meeting of the American Association for the Advancement of Science, Convocation Week, 1914–15, there was held, under the auspices of the American Society of Naturalists, a symposium entitled "The Value of Zoology to Humanity." I was, unfortunately, very busy with the affairs of the general association and was unable to attend this symposium. There were four papers presented. The first of these is printed in SCIENCE for March 5, 1915, and is entitled "The Cultural Value of Zoology." The address was given by Professor E. G. Conklin, of Princeton. It is a very readable address, full of interest, containing much of that delicate humor characteristic of Professor Conklin, and possibly rises nearly to the exact height demanded by the title. But it is not a zoological address, in spite of its title. It is broader, and comprehends all biology. It is divided into two headings: (1) "Contributions of Biology to Education"; (2) "Contributions of Biology to Civilization." Under the first heading he dwells upon the immense enthusiasm and intense concentration of the biologist in his work, touching upon the evil effects of over-specialization and referring to the few great leaders in biology who have become interpreters to the plain people—men like Huxley, Galton, Metchnikoff and Forel, who have applied the teachings of biology to social problems.

[1] Read before Section F (Zoology) of the American Association for the Advancement of Science in a Symposium upon "The Contributions of Zoology to Human Welfare," Pittsburgh, Pa., December 31, 1917.

He then dwells upon the powers of observation and imagination of the biologist, and the unique place which biology occupies among all the sciences in its cultivation of esthetic appreciation and broad sympathies. He admits that these elements of personal culture are not absolutely distinctive of the biologist, and that "some good men in other fields are biologists gone astray."

Among the contributions of biology to civilization, he refers to the conquest of nature by all of the sciences, and suggests as a topic for general debate at the San Francisco meeting of the association, "Who built the Panama Canal?" feeling sure that biology would be able to show that it deserved "a large share of the credit." Without entering into detail, he states that, while biology is not generally considered the equal of physics, chemistry or engineering in its contribution to civilization, agriculture, animal breeding, bacteriology, experimental medicine, pathology, parasitology, physiology, sanitation, are all based on biological research.

It is the summary way in which Professor Conklin dismisses this aspect which, I think, weakens the effect of his address, for he goes on in his final consideration to the statement that "the highest service of science [mind you, science in general] to culture has been in the emancipation of the mind, in freeing men from the bondage of superstition and ignorance, in helping man to know himself." As a generalization this is fine, and he goes on to state that the doctrine of evolution which has revolutionized all our thinking regarding man and nature is the greatest contribution of biology to intellectual emancipation. His concluding paragraph is:

> Biology has changed our whole point of view as to nature and man, and has thus contributed more than any other science to the emancipation of mankind.

Another of these four papers was read by Professor G. H. Parker, of Harvard University, and was entitled "The Value of Zoology to Humanity: The Eugenics Movement as a Public Service." Here again we have an extremely interesting and important article, from which we may quote the conclusion only:

> To conclude, eugenics in the service of society is, in my opinion, entirely justified in demanding the sterilization by humane methods of those defectives who are in the nature of public wards, and this practise may be extended as experience dictates. Eugenics in its relation to propagating the best in the community has a fundamental position in that it is concerned through the elimination of the extremely unfit with the delivery of a reasonably sound stock for cultivation, but it is only secondarily connected with the final production of efficient members of society whose real effectiveness is often more a matter of social inheritance than it is of organic inheritance.

I consider Dr. Parker's address as a very valuable one, but, while showing what animal breeding has done, which may in a way be construed as relating to "the value of zoology to humanity," he uses this only as an indication as to what might be done with the human species; and, important as his address is, it is not directed specifically to the point at issue—the value of zoology to humanity.

The third of these addresses was by Dr. C. B. Davenport and was entitled "The Value of Zoology to Humanity: the Value of Scientific Genealogy." Here again we have a very important paper, written in Dr. Davenport's admirable manner. His argument in a broad way applies to the general field of biology, including botany, zoology and anthropology, and in a specific way to the human species. He refers to the complicated work of the animal breeders, and follows it with the statement,

> And yet this precious human kind of ours, whose progress is so fatal to the world, goes its blind way, like any jellyfish, mates almost at random and

then, after two or three generations, has lost all knowledge of the matings that have gone before. Of course, the race has got along, somehow, just as the lower animals get along; although we have been burdened with an intelligence sufficient to lead us to interference with the operation of pure instinct but not sufficient always to interfere wisely.

He instances especially, as indicating that the nature of the mating influences the progeny, the study of half fraternities, and mentions especially the case of a man born in 1668, a graduate of Harvard, whose wife was the sister of the first rector of Yale College, who entered the ministry and preached in southeastern Connecticut. His first wife was apparently a quiet, steady, religious woman of no apparent wealth or culture. Her children were farmers, and received no special education. His second wife belonged to a wealthy New York family, of high social standing and culture, and the children by this wife were educated at Yale College and became prominent in the affairs of the nation. The thought that occurs to almost any one in studying this case is that the wealth acquired by the second marriage enabled the superior education of the children which it produced, and that obviously education and environment brought about a very considerable contrast between the children of the two wives.

The whole paper, however, is a sound and striking argument showing the value of scientific human genealogy, a proposition, however, which most of us are ready to accept without any extended argument. The paper as a whole touches upon a single aspect of the main subject of the symposium, and this aspect in itself has only been thought of as zoological of late.

The final contribution to the symposium was on the value of museums, by Dr. Henry Fairfield Osborn. This too is a rather self-evident proposition. The address has not been published, but it is certain that the zoological work of the museums was more than competently handled. Dr. Osborn, as every one knows, entirely aside from his eminent standing as a paleontologist, is an expert in museum management, and has published many papers on the subject.

The symposium of 1914–15, as a whole, as pointing out in a comprehensive way the value of zoology to humanity, is very disappointing and by no means does justice to the subject. In fact, it touches on only four aspects of the topic and these by no means of the first importance; and, moreover, in one of the papers it confuses zoology with general biology if not scientific thought as a whole.

No one denies the abilities of the speakers, who were, and are in fact, four of the most prominent among the American workers in zoology, and any one of them, if given the whole field, would doubtless have made a magnificent showing. To each, however, was assigned a subtitle, and thus the value of zoology to humanity received a most unsatisfactory treatment. One prominent worker in zoology as applied to medicine, I am told, left the meeting undecided whether to relieve himself by jeers or by tears, and it was at his suggestion that the present supplementary symposium has been arranged. Mind you, this one will not be sufficient unto itself, since each speaker is assigned one general topic, but if it properly supplements the other it ought to outweigh it in proportion of anywhere from ten to one hundred to one.

And now let us see what those zoologists who study insects have done and are doing for the welfare of humanity. The class Insecta includes a host of species which are most keenly competing with the human species in the struggle for existence. The

insect type is one of the most persistent types in nature. Having its origin in Carboniferous or perhaps Silurian times, it has persisted and flourished, adapting itself to almost all conceivable conditions until at the present time it is, among all the types of living things, the chief competitor of the recently evolved human type for the control of the earth.

Man labors for months to produce a food crop—he must share it with many species of insects. He builds himself a house with infinite toil—it must harbor insects as well. He makes garments for himself—without great care on his part they are eaten by insects. His harvested food is destroyed by them; his blood is sucked by them; he sickens and dies from a multiplication of disease germs which they have introduced by their bites or with which they have contaminated his food, and after his death they consume his body.

Let us begin with food crops. Always a vital subject, this has become one of the most intense interest under the present world conditions. In time of peace and before the intensified effort was begun to feed not only ourselves but a large part of the rest of the people of the world, the damage by insects to the food products of the United States was estimated at approximately $1,300,000,000 per year, or roughly, about ten per cent. of the whole. This estimate, as expressed in monetary terms, is open to criticism for the obvious reason that a fall in production is followed by an increase in price. But the loss may equally be estimated in terms of human food and consequently of human vitality. A loss of ten per cent. of the possible food, and not considering the question of waste, means strictly that a given number of people must live on a ration of ninety per cent. of the possible; not necessarily that ten per cent. of the people must die of starvation.

Accepting the monetary terms as the most convenient, let us see what the zoologists have done in this direction for the "welfare of humanity."

In 1907 the question arose (it was propounded by Mr. Littlefield, at that time chairman of the Committee of the House of Representatives on Expenditures in the Department of Agriculture) as to how much the work of the Department of Agriculture saves to the country annually. Secretary Wilson passed this question on to the chiefs of the bureaus. The Chief of the Bureau of Entomology passed it on to the heads of different sections of the work of the bureau. When the entomological estimates were handed in they summed up the total of $500,000,000, and they appeared to the Chief of the Bureau to be incredibly large, and the total was scaled down to less than one half. When the resulting estimate from the chief was submitted to the Secretary of Agriculture it appeared to Mr. Wilson to be still very much too large (possibly in comparison with the saving resulting from the work of the rest of the Department of Agriculture), and he in turn scaled it down to more than one half of this half. When the totals came to Mr. Littlefield in his committee room, the estimates of the whole department appeared to him to be very much too great, and he scaled down both individual items and totals, including the estimate from the Bureau of Entomology. The result as published in Mr. Littlefield's report gives the annual saving from the labors of the Bureau of Entomology (which is only one of the organizations of zoologists at work in this direction) as $22,750,000. But who shall say whether the original estimates of the chiefs of sections in the bureau were not more nearly correct than this? In fact, it seems more likely that the entomologists have saved to this country much more

nearly the original estimate of the experts than the final estimate of the Congressional committee. I have shown that our estimate of the loss is based at about ten per cent. of the possible production of our crops taken as a whole. Who is in position to say that it would not be twenty per cent. were it not for the general use of remedies already found and continually being improved by the students of insects?—in which case the saving would be more than a billion of dollars a year to the United States alone. And how many people can be fed with a billion dollars a year, and what work could they do!

This is perhaps the high spot in our treatment of this subject. It must be remembered that the work which brings about these results is done for the most part by trained scientific men. To find a remedy for an injurious insect presupposes a long training followed by the closest observation. It includes a broad knowledge of the structure, of the classification, of the life histories, of the behaviors of the species involved, of laboratory methods and technique, and that inspired insight which is a part of the nature of the best men of science. Workers in pure science are inclined to look down on workers in applied science, but nowhere have the qualities of the research man come into closer play than they have in the investigations in economic entomology along the line of crop enemies; and the same may be said of all of the other work in applied zoology.

We are accustomed to think of the insect enemies of growing crops as those of main importance, but after the crops are harvested and food products are stored they are attacked by a host of species. In the present crisis the problem of preserving food stuffs for considerable periods after harvest from the attacks of insects has become of the utmost importance. Long before the Russian revolution a conference of all of the entomologists of Russia was held to consider this very question. During the present month one of the most experienced entomologists of England, Professor H. Maxwell-Lefroy, passed through this country on his way out to Australia to look into the condition of Australian wheat ready for export to the United States, for the purpose of preventing damage by weevils and other insects injurious to stored grain. Much depends on the success of this man. Conditions are readily conceivable under which this great store of grain, which means so much to this country at the present time, may be utterly destroyed—an almost catastrophic prospect—and any reduction in its amount will upset the close calculations which concern themselves with the vitally important grain trade of to-day. The United States has sent milled grain in great quantities to England. To avoid the long sea haul, Australian grain will go to the port of San Francisco and will be milled in this country to replace the supply already sent to the East.

And then comes the enormous problem of medical zoology, in which the entomologist has a most important interest. Other aspects of this question will be treated by another speaker, and it is true that most of the important discoveries concerning the carriage of disease by insects have been made by medical men and not by entomologists. But even in these cases, the discovery once made, the entomologist, with his training in methods of investigating the life history and habits of insects, plays the important part in the investigation of every point in the life history, habits and behavior of the insect carrier and in the perfection of the methods for its destruction. I have even gone so far as to state, what to me seems a self-evident fact, that the prevention of insect-borne diseases is a matter

for the economic entomologist and not for the medical man; or, at the very least, for the individual who does not yet exist, namely, the medical man trained as an entomologist. It is true that the practise of the results obtained by the research of medical entomologists may eventually be placed in the hands of men of lesser training or of men who possess other sanitary qualifications, such as the sanitary engineers, but the entomologist is a vital link in the chain. Entomologists, as such, will receive more and more consideration from sanitarians, especially in Army circles, as is indicated by the fact that, from a zero beginning in 1914, at the present time with each sanitary unit of seventy in the expeditionary forces of Great Britain there are two trained entomologists.

I might easily have prepared a paper of ten times the length of this and adding to its effectiveness, but other speakers are waiting to add their expert testimony to the enormous "value of zoology to the welfare of humanity." L. O. Howard

THE STATUS OF PHYSIOLOGY IN AMERICA

In a recent issue of our most widely read medical journal[1] there is presented an arraignment of modern biology which can not be passed by without serious consideration. This is so not because the writer of the review has presented the case exhaustively, or even fairly, but because the statements are commonly made and therefore deserve examination.

Modern biology is a composite, its several components derived from the following sources:

1. Traditional natural history of pre-Agassiz times.
2. The laboratory period of Agassiz.
3. The morphological period of Darwinian corroboration and consequences of the "Origin of Species."
4. The newer physiological aspects, introduced by the experimental school.
5. The dictations of the professional schools—medical, agricultural, etc.

Of the two great divisions, botany and zoology, the former has exhibited a more catholicity of view. Unlike zoology, the curricula of departments of plant study offer a more complete survey of the essential aspects of the subject. Both the functional as well as the morphological divisions are presented, for a typical curriculum of botany includes not only the morphological studies, similar to those of the department of zoology, but an integrated division of plant physiology, part and parcel of the department. To find an equivalent to this state of affairs in zoology, one must confine himself to a comparatively few of our institutions of learning. A typical case is presented by Princeton, and the result, indicated by the character of investigations produced from the department of biology of that university, has apparently justified the incorporation of functional study into the department. However, such instances are the exception rather than the rule and the number of institutions which embody this idea increase at a very low ratio from year to year.

The arrangement which is practised in many institutions is that which is exemplified by Columbia University. The department of zoology includes a professor of experimental biology and the courses presented by him are physiological, to be sure; yet these courses are advanced and are specialized for certain research work with which the department has been identified since 1904. For the undergraduate, nothing is available as far as a survey of functional zoology is concerned; that work is relegated to the medical school. In this respect, as we have said before, Columbia is typical inasmuch as the zoologist *leaves to the medical school the functional aspects of his science.*

Owing to the growing potency of the fifth factor mentioned above in our enumeration of the various components of modern biology, this condition of affairs is growing *pari passu*. At California, where traditionally the depart-

[1] *Journal of the American Medical Association*, September 29, 1917, column Book Notices.

ment of physiology was general in its bearing, to-day we find it incorporated under the medical components of the university. Now there is nothing more evident to one who takes the trouble to investigate for himself than that the medical school is distinctly a vocational element, participating seriously in the modern "Zweckmässigkeit" or teleology which is insinuating itself more and more into our social fabric. In many ways, this is as it should be. Medicine, besides being a science, or composite of all the sciences as far as they can be made to bear upon human welfare, is likewise an art; and the practical aspects hold sway more tenaciously in the country at large than in some of our eastern medical institutions, such as Johns Hopkins, so that one must not judge of the spirit of medicine from a few chosen, advanced institutions such as the one we have mentioned. In fact, the pure science leanings of Johns Hopkins and other medical schools have been utilized in certain quarters as destructive criticisms of these institutions in their rôle as purveyors of medical training. More and more the intensely practical "fruit-gathering" functions of the medical school are being emphasized.

Now all this has direct bearing upon the matter in hand. We have seen that zoology, typically, leaves to the medical school the functional side of its work. We have seen, too, that the typical aspect of the medical school is teleological, the end being the production of practical physicians. Consequently, the physiology of the medical school is attuned to the obtaining of results bearing directly upon human material. Muscle-nerve preparations are paramount upon the one side, metabolism studies upon the other. The zoological, that is the comparative, or general aspects of the living thing are approached casually. In the nature of the case, this must be so; *the problems of the medical physiologist are succinct and different from those of the zoologist.* It is to be considered an imposition for this condition of affairs to exist, for the medical physiologist gains little from his associations with the student from the department of zoology, whereas the zoologist gains materially from the association, yet so crowded and interdigitated are the various activities of the medical school that, save in a few cases, it is stealing the time from the professor and assistants to handle the zoological physiologists. Of far greater importance, however, from the side of efficiency is this: The zoological student gains the impression that the fundaments of the study of living functions can be gained from the presentations of the medical physiologist who deals with human and mammalian material. In common parlance, he is not getting his money's worth.

Physiology, then, falls into the following distinct groups:

1. General physiology, found in such isolated examples as may be culled by a perusal of the catalogs of our universities and colleges.
2. Botanical physiology, a part of departments of botany.
3. Zoological physiology, rarely presented as such.
4. Applied physiology:
   (*a*) Medical physiology.
   (*b*) Agricultural physiology, etc.

The statement is frequently made by applied physiologists that they are presenting the subject in a broad way and making what is essentially "general or biological physiology" out of their work. Nothing is more evident from such statements than that there is extant a distinct failure to grasp what is meant by the terms general or biological physiology. Let us take an example: One of the most successful teachers and men of research in physiology to-day presents an opening course in physiology. The content of the course consists of the familiar experiments in muscle-nerve physiology, as a background; why is not the muscle-nerve preparation sufficient to demonstrate the essentials of contraction, irritability, etc., which are the fundamental characteristics of protoplasm everywhere? Is there anything more "general" or more "biological"? The answer may be given in various ways, but scarcely save in the positive. There are many ways of presenting more fundamental factors, for in the first place, while

contraction is indeed one of the fundamental properties of living beings, you have selected in the muscle-nerve preparation a highly specialized mechanism which may have nothing essentially to do with contraction as it occurs in more undifferentiated protoplasm; the fact that this same professor presents, in connection with the muscle-nerve preparation, the theories of construction of cross-striated muscle fibers is enough to cause one to pause in stating that he is dealing with a case of "fundamentals." As for the nerve, we have again a highly specialized organ for the transmission of impulses, which bears many differentiations, totally unlike what exists in the lower forms where transmission of stimuli proceeds. For the medical student, for whom these courses are designed, nothing could be better and the success which this man obtains with his methods in inculcating the knowledge which should be a part of all medical training is indicative of the fact that he is on the right track.

However, for the biological student, the course is inadequate. There is a wealth of material which can be presented in actual laboratory work concerning the fundamentals of protoplasm in general and of irritability and contractility in particular. What is needed is the simple recognition, born of actual experience, that such possibilities exist. They are appreciated in various quarters and the writer has found them recognized in even a medical school within the limits of the city of Boston, where they are not alone appreciated, but actually incorporated into the medical curriculum, in a small way, to be sure, but nevertheless therein.

It is not within the purport of an article of this kind to attempt to outline the presentation of general, or biological physiology. It may be sufficient to say, however, that were the catholicity of view of the average botanist equally well developed in the students of zoology, there would be no demand, as seems actually to exist, for an outline of a course in general or, specifically, zoological physiology. It is not biologists in the strict sense of the word who need the education, but zoologists. The difficulty centering about this one group of scientists demands elucidation; why is it that the average student of zoology is less familiar with function than the student of botany?

The answer to this question must not be that the departments of botany, as we have said before, present functional studies, while the departments of zoology do not; that is not a reason. *The adequate reason lies in the point of view.* For the plant student, there is no line of demarcation between form and function. The structure of the leaf is taken as a matter of course in terms of transpiration and of photosynthesis; one is not complete without the other. In elementary botany, these functional considerations are presented. What course of elementary zoology, even of the college grades, teaches the student the rudiments of the most important of all the properties of organisms, namely, oxidation? The minutiae of the nervous system of the cray fish are followed, yet the simple fact which we have just mentioned must be delegated to another department for presentation, that is, to the physiologist.

Morphology has been adhered to in a large manner on account of its supposed superior pedagogical value. Here are things succinct and things one may feel and handle.

From the tangible to the intangible in the perfect method. For reasons such as these, morphological aspects have held the center of the stage. Additional reasons have been of historical nature. The science of biology is still concerned with the method of evolution; witness the "fashion" of genetics, so all-absorbing that the subject dominates the cementing society of biological societies—the naturalists, together with an organ, one of the first of its kind in this country, namely, *The American Naturalist*. Now genetics *can* apply and do apply, as has been shown abundantly, to function but, for class presentation, form is much easier. Following the enunciation of the so-called Darwinian Theory, came a long line of verifiers and exemplifiers, who piled up the mass of data which has been systematized into our modern conception of

how evolution works. Function played a minor rôle in these classic studies, comparative anatomy, comparative embryology, comparative paleozoology and paleo-botany—all concerned with form, holding the fort. Hence, it is quite natural that these subdivisions of biology should persist with a lion's share for a time. In fact the generation of comparative anatomists, comparative embryologists and other morphological students is still with us. When we consider that the so-called "experimentalist" school, arising with Roux, Morgan, Loeb and others, took its inception only somewhat over a score of years ago, and that this school has been the first to direct the attention of zoologists to fields other than those cultivated by the verifiers of Darwin, we should not wonder that the fundamental aspect of biology, as far as teaching is concerned, which changes slowly, is principally morphological.

Now it is an interesting suggestion that although the biologists following Darwin were distinctly students of form, the founder of the theory which bears his name, along with his immediate associates, such as his "Bull-dog, Huxley," were really more interested in function than in form. Darwin's studies in climbing plants, in mould formation and in other things which may be called "dynamic," were of the spirit of the physiologist; he was interested in the manner in which the things worked, rather than in the varieties of form. Huxley for his part lamented that his career had not carried him closer to physiology.

We have seen how morphological aspects dominated and still dominate biology, especially zoology, even in the face of the early appreciation of things dynamic by the men whose researches gave inception to our sciences of biology. We have now to learn why physiology has been so slow to become recognized by the zoologists.

Mammalian physiology has outstripped all other functional studies. The medical school has persisted as a continuum from the times of the Greeks. Moreover, we should recognize why it has existed as a continuum; its relation to the art of medicine has insured this. Given a subject which has intimate bearing upon not alone the welfare of the human individual, but upon his very life, we may well suppose that it will develop faster and receive more prompt attention than a subject which, although perhaps bearing likewise upon the welfare of man, yet does not do so directly. It is natural then that the medical physiologists should have the lion's share of function. Medicine, again, is intensely eclectic, hunting and prying into the uttermost corners of human experience for things which it may take to itself and make a part of its own fabric. Consequently, we have been deluded with the apparent catholicity of human physiology and have been resting securely in the belief that it would take care of all our functional problems, be they of human reference or more general. It is true that the human physiologists have contributed largely to all that is worth while in functional studies. It is likewise true that they have failed to pursue the enigma beyond their own field save in isolated cases. They have always been interested in the cell studies of the biologist, but their contributions have been meager. We have instances, such as the classic researches of Fr. Miescher upon the cells of pus formation, out of which came our modern conception of the construction of nucleic acid at the hands of Jones and P. A. Levine; the studies of Claude Bernard upon oxidation of sugars; the fundamental studies of energetics (or thermodynamics) of Rubner, Atwater, Benedict and others; yet these studies are but instances and emphasize the paucity of contributions of medical physiologists to the fundamental problems of the cell, which, if we agree with the great pathologist, Rudolf Virchow, represents the *terminus ad quem* of all biological work, be it "biological," botanical, zoological, medical, or what-not.

The fact remains, then, that if the zoologist is to round out his science, making it equivalent for animals what botany is for plants, he can not expect the medical physiologist to take care of his problems in animal function. Comparative physiology, which has received a strong impetus in the "Handbuch" of Winterstein and in that of Jordan, will never

thrive in the medical school; there is no place for it and the tendency in the modern medical curriculum is to eliminate rather than to add to the already over-crowded subject list. Moreover, general physiology will find no place, for the aspect of functional study is from the top downward, from man towards the lower groups; the cell will continue to be treated as an interesting organ, even as the liver is considered, but its study will progress in the medical laboratories only so far as the problems are of medical importance of a more immediate nature.

What, then, is to become of general, or what we may term zoological, physiology, granting that botanical physiology is in good hands?

There are no agencies, save a very few, whereby a prospective student of zoological physiology can gain the training necessary for his work. We must eliminate the medical courses in physiology and in physiological chemistry. Zoology must recognize the importance of taking care of its own ground and develop means of deriving a line of zoological physiologists. It must cease to permit men like our Gortners, McClendons, Mathewses, Lyons and others to be taken by the medical and other professional schools from biology into lines where their promises as students of fundamentals cease. Unless this is done, the considerate criticisms, such as the one we have referred to at the beginning of the present communication, that modern biology is in a parlous way; that it is unproductive and dealing with blue ethereal theories, and that its face, which should be directed as that of Janus, before and backward, is cast towards the old, rather than the new.

What the agencies must be which will be capable of bringing biology into line with its sister science, is a matter of lengthy discussion. The conditions are ripe for the production of a new order of work in dynamic biology, for the methods which have been worked out within recent years at the hands of Winterstein, Folin, Taschiro, Van Slyke, and others —the so-called "micro" methods applicable to small material afford an excellent place for beginning. Thus far the field is practically virgin. From the investigation side, then, we are ready. From the pedagogical aspect, as Mark Twain remarked about the weather, the discussion is plentiful, but nothing is done; zoologists want the development of more function, but they do not know what to do about it. Not trained themselves to carry classes in the subject, they are at a loss as to the method of procedure. There is but one way: Induce students entering biology to specialize as best they may to fill positions in dynamic biology and reward their efforts when they have been successful by instructorships and higher positions in their turn, in the departments of zoology. This programme has been actually put into force in one university. The great desideratum, however, is that the opportunities be more attractive than those offered by the medical departments of physiology and biochemistry.[2] Otherwise the same gravitations to these schools will take place as in the past. It is not a matter of salary altogether; it is mainly the creation of the appreciation for the work of these students. Again, it is undesirable that the studies should involve complicated apparatus, unfamiliar and expensive chemicals, etc. The simpler the more efficient will the work become. The plant physiological apparatus and methods of men such as Professor Genung are simple, inexpensive and readily appreciated by the student; the same should apply to general physiological methods and apparatus. It is not necessary to measure the hydrogen ion concentration in a class of this nature, especially where it is desirable to do so by complicated means, such as by a potentiometer for E.M.F. In this one instance, we have the extremely simple method, if it is necessary at all to present the matter to a class in functional zoology, of Marriott. Much better than any, is to eliminate the methods necessitating a fairly high degree of previous experience in physics and chemistry; enough will remain of fundamental importance which may be studied by the microscope, the test-tube and a few simple pieces of apparatus.

[2] The writer is using the words of the late Professor F. P. Mall.

It is only by such means that biology is to maintain its place. The science has justified its existence, to be sure, in the unravelling of the complicated skein of genetics and sex. However, to eliminate criticism concerning the ability of zoologists to speak glibly of enzymes and catalyzers, or sex hormones and of chemical determiners, they should fortify themselves by a strong development of functional biology.

MAX WITHROW MORSE
6034 JACKSON PARK, WEST,
CHICAGO, ILL.

SCIENTIFIC EVENTS

AURORA AND MAGNETIC STORM OF MARCH 7-8 IN ENGLAND

THE auroral display is said to have attracted much attention, partly because it coincided with an air-raid upon London. The northern sky was lighted up with a crimson glow both before and during the raid, which started shortly after 11 P.M.; and the appearance was thought by an observer at Folkstone to be due to a distant fire. Sir Napier Shaw informs *Nature* that the Meteorological Office has received reports of aurora observations from Lerwick, Stornoway, Eskdalemuir, Donaghadee, Liverpool, Clacton and Southend, and forwarded the following account, by Dr. C. Chree, of the large magnetic disturbance recorded at the Kew Observatory between 9 P.M. on Thursday and 5 A.M. on the following morning. Mr. A. Lander has sent *Nature* photographic traces of movements in declination recorded at Canterbury during Thursday and Friday. Thursday's trace was remarkably even until shortly after 9 P.M., when the magnetic storm began. *Nature* remarks that it is possible that the disturbance was a repetition, after three 27-day intervals, of the large magnetic storm of December 16-17, 1917. There was a very considerable disturbance on January 12 at the end of the first 27-day interval, and a minor disturbance at the end of the intermediate interval in February.

Dr. Chree wrote: "A magnetic storm of no great duration, but very considerable amplitude, was recorded at Kew Observatory on the night, March 7-8, 1918. It began with a 'sudden commencement' at about 9h. 10m. P.M. on March 7. The largest movements occurred in the early morning of March 8, between midnight and 5 A.M., but smaller oscillations persisted for some time after the latter hour. The 'sudden commencement' was especially prominent in horizontal force (H); after a small, sudden fall there was a sharp rise of fully 60γ. The corresponding movements in declination (D) consisted of an oscillation of about 4′, the first movement being to the west. The range shown on the D trace was about 51′, the extreme easterly and westerly positions being reached at 2.20 A.M and 4.16 A.M. respectively on March 8. Between 1.11 A.M. and 2.20 A.M. of the same day there was a movement of 36′ to the east. The range on the H trace was about 240γ. A very rapid downward movement commenced about 2.3 A.M. on March 8, the fall during the next thirty minutes amounting to fully 185γ. After 5 A.M. on the same day there were only short-period oscillations in H of moderate size; but up to 10 A.M. the element remained depressed by fully 70γ as compared with its value on the previous day before the storm."

THE STEAM ENGINEERING TRAINING SCHOOL AT THE STEVENS INSTITUTE

THE Navy Department has designated the Stevens Institute of Technology, Hoboken, N. J., as the headquarters for the new United States Naval Steam Engineering School for the training of engineer officers for the U. S. Naval Auxiliary Reserve.

This school is the only one devoted to training engineer officers for *steam-engine service*, and is a branch of the large training school now located at Pelham Bay Park, New York. There is at Pelham, in addition to the school for general training of enlisted men, an Officers' Material School, Naval Auxiliary Reserve. Both the school at Pelham and the engineer officer school at Stevens are under the supervision of the Supervisor, Naval Auxiliary Reserve. The education of the engineer officers at Stevens is directed by Professor F. L. Pryor, of Stevens, who has been appointed

by the Navy Department, with the approval of President Humphreys, civilian director.

It is contemplated to make a five-month course for the training of an officer; one month to be devoted to military and ship duties training at Pelham; one month at Stevens to receive the preliminary requirements and duties of an engineer; one month in inspection and repair duties at local shipyards, machine shops and boiler shops; one month at sea in the engine room of different type boats; and one month subsequent training and examination at Stevens. It is expected to have about one hundred men in each of these divisions, or five hundred in all.

Three of the divisions will be quartered in barracks now in the course of construction on the college grounds at the corner of Sixth and Hudson Streets adjoining the Carnegie Laboratory of Engineering. The school divisions will attend classes in the lecture rooms of the college, and will take their meals at the college mess hall at Castle Stevens.

The instructors for the school, with the exception of the civilian director, will be regularly appointed commissioned officers of the United States Naval Auxiliary Reserve and will be selected particularly for their special work.

Quotas are furnished for this school by the various Naval Districts throughout the country as outlined by the Navy Department and are required to meet the following qualifications:

(*a*) Men of ability and officer material.
(*b*) Age 21 to 30 inclusive.
(*c*) Completed high-school course, and graduate of engineering course at a recognized technical school or an equivalent of the above.
(*d*) Must be regular Navy, N.N.V., or N.R.F. (any class) for general service.
(*e*) Physically qualified for line officer—standard of regular Navy.

ENGLISH MEDICAL STUDENTS AND MILITARY SERVICE

We learn from the *British Medical Journal* that the Minister of National Service has issued detailed directions with regard to the "protection from military service of medical students" now in civil life. These may be looked upon as the obverse of Army Council Instruction No. 153 of 1918, which governs the release of medical students from the ranks. (1) A medical student who on March 5, 1918, was a full-time student at a recognized medical school, and had at that date passed his professional examination in chemistry, physics and biology (or botany and zoology) for a medical degree or license is not (subject to paragraphs 5, 6, 7 and 8, below) to be called up, whatever his medical category or grade, so long as he remains a full-time medical student. (2) A medical student who on March 5, 1918, was a full-time student at a recognized medical school, and furnishes to the A.D.R. of his area a certificate from the dean, or corresponding official, of his medical school that he should be able to pass his first professional examination as above on or below July 31 next, is not to be called up before July 31 next, whatever his medical category or grade. If he passes that examination by July 31 next his case will thenceforward be treated as if covered by paragraph 1. If he does not pass by that date he will forthwith be called to the colors if otherwise available and required for service, unless he comes within the terms of paragraph 3. (3) A medical student (other than one whose case is covered, or is to be treated as if covered, by paragraph (1) who is or becomes a full-time student at a recognized medical school, and who is in Category B 2, B 3, C 2 or C 3, or is placed in Grade 3, is not (subject to paragraphs 4, 5, 6, 7 and 8) to be called up, so long as he remains a full-time student, without reference to the Director of National Service for the region. (4) A student protected under paragraph 3 who does not within twelve months of commencing his professional studies at a recognized medical school pass his first professional examination as above, will forthwith be called up if otherwise available and required for service. (5) A student protected under this instruction who fails to pass his professional examination in anatomy and physiology within thirty-six months of commencing his professional studies at a recognized medical school will similarly be called to the colors. (6) For protection

under this instruction a student must be enrolled in an O.T.C. and fulfil after enrolment the conditions of efficiency laid down for medical cadets. (7) Protected students delaying qualification unnecessarily, or otherwise not satisfactorily pursuing their studies, are to be referred to the director of National Service. (8) Protection will be withdrawn from a student who has been requested in writing by the Ministry of National Service to offer himself as a surgeon probationer, R.N., and has not within twenty-one days applied for enrolment as such. The remaining paragraphs of the instruction—which supersedes all previous instructions relating to the protection of medical students now in civil life—deal with formalities to be observed in the matter of certificates and of applications to tribunals in respect of medical students not hitherto called up but now no longer protected.

WAR WORK OF THE U. S. COAST AND GEODETIC SURVEY

Under the provisions of section 16 of an act approved May 22, 1917, and regulations established in accordance therewith, any of the vessels, equipment, stations or personnel of the survey may be transferred by the President in time of national emergency to the service and jurisdiction of the War Department or the Navy Department, and the same may be retransferred to the service and jurisdiction of the Department of Commerce by the President when the necessity for such service no longer exists.

By executive order dated September 24, 1917, the steamers *Surveyor, Isis* and *Bache*, their crews and 38 commissioned officers of the survey were transferred to the Navy Department, and 29 commissioned officers and 10 members of the office force were transferred to the War Department with military rank corresponding to their grade in the survey.

Some changes were made in the assignments of these officers; some were rejected for physical or other reasons and were returned to the survey by executive order and others were afterwards assigned in a similar manner. Some members of the crews of the vessels declined to enroll in the Naval Reserves and their places were filled by the Navy Department. Some employees of the office force and hands in field parties were drafted and others enlisted voluntarily in the Army or Navy. On March 1, 1918, 65 commissioned officers of the survey, 17 members of the office force, 5 ships' officers, 67 seamen and other employees of vessels and 21 hands from field parties, a total of 175 persons, were serving in the Navy or Army.

In conformity with the wishes of the Navy Department, after the beginning of the war all of the topographic, hydrographic and wire-drag work of the survey was directed so as to meet the most urgent military needs of the Navy Department. The work done comprises wire-drag surveys on the New England coast and coast of Florida; hydrographic surveys on the South Atlantic coast and Gulf of Mexico; the beginning of a survey of the Virgin Islands; the investigation of various special problems for the Navy Department; wire-drag surveys, current observations, and special work on the Pacific coast; and surveys in the Philippine Islands.

The work undertaken for the War Department by the field parties of the Coast and Geodetic Survey was intended to furnish points and elevations for the control of topographic surveys for military purposes. To expedite this work an allotment was made from the appropriation for the War Department to cover the expenses of the field parties employed. The chief of the division of geodesy was authorized to confer with officers of the Corps of Engineers, United States Army, and officials of the Department of the Interior in regard to the proper coordination of the various operations.

Extensive surveys were undertaken, including primary triangulation, primary traverse, precise leveling and determination of differences of longitude, and good progress has been made, and the results of previous surveys have been made available by copies or in published form as promptly as possible. From April, 1917, to January, 1918, 80 per cent. of the time of the office force of the geodetic division was devoted to war work. At the request of the War Department tables were computed for

the construction of maps on the Lambert projection. The Chart Division has done much work in the compilation of maps, furnishing copies of original sheets, and supplying information of various kinds required for military purposes.

SCIENTIFIC NOTES AND NEWS

The University of California has conferred the degree of LL.D on Professor George F. Swain, of the Massachusetts Institute of Technology and Harvard University, who this year delivered the Hitchcock lectures at the University.

Oxford University has conferred the degree of D. Sc., on Professor W. C. M' Intosh, for many years professor of natural history in the University of St. Andrews.

The Paris Academy of Sciences has elected M. Flahaut of Montpellier to take the place of the late M. Gosselet. He has been the correspondent of the academy for the section on botany since 1904.

Sir J. J. Dobbie, British government chemist, has been elected a member of the Athenæum Club for eminence in science.

We learn from *Nature* that an Entomological Society of Spain has lately been founded, with its center for the present at St. Saviour's College, Saragossa. Dr. Hermenegildo Gorría, of Barcelona, is the president for 1918, and the Rev. R. P. Longinos Navás, S.J., the secretary.

The Bureau of Standards has announced the appointment of Samuel S. Wyer, a consulting engineer of Columbus, Ohio, and Mr. Willard F. Hine, chief gas engineer of the Public Service Commission of the First District, New York State, as consulting engineers on its staff.

Dr. Samuel A. Tucker, of Columbia University, Dr. H. R. Moody, of the College of the City of New York, and J. M. Moorehead, of Chicago, have been added to the personnel of the chemical section of the War Industries Board.

Dr. John Lyon Rich, of the department of geology at the University of Illinois, has been commissioned a captain in the National Army. He is assigned to Washington, D. C., for service in the Intelligence branch of the army as a specialist in geography.

Captain R. G. Hoskins, of Northwestern University Medical School, Captain L. A. Congden, Lieutenant F. A. Cajori and Lieutenant A. G. Hogan, have completed a month's study of army nutrition at Camp Zachary Taylor, Louisville, Ky. They comprise a "Nutritional Survey Party" from the office of the Surgeon General of the Army.

Dr. W. A. Cannon, of the Department of Botanical Research of the Carnegie Institution, sailed in April to Australia and will be away from the United States about twelve months. He will visit certain of the more arid portions of West and South Australia where he will make field studies of the desert plants with especial reference to root habits.

We learn from *The Journal of Industrial and Engineering Chemistry* that Dr. Yogoro Kato, professor at the Tokyo College of Technology and director of the Nakamura Chemical Research Institute in Tokyo, is visiting the United States for professional purposes and Mr. T. F. Chin, of Pekin, China, principal technical expert of the Chinese Ministry of War, is in this country with the Chinese mission to make purchases for the outfitting of an extensive chemical laboratory at Pekin for his government.

Professor T. L. Haecker, of the University of Minnesota, who has been asked for several successive years to continue his experiments in animal nutrition, despite the fact that he has passed the usual age for retiring from service, will retire at the close of this college year, July 31, 1918, and provision will be made for completing the work upon which he is engaged and for tabulating the results.

Dr. Eugene R. Kelley, Boston, has been appointed state commissioner of health to succeed Dr. Allan J. McLaughlin, who has been called back into the federal public health service.

Dr. Buford Jennette Johnson, Ph.D. (Hopkins '16), has resigned her position as assist-

ant psychologist in the Laboratory of Social Hygiene, Bedford Hills, N. Y., and has accepted an appointment as research assistant in the Bureau of Educational Experiments, New York City.

Dr. Oliver W. H. Mitchell has resigned as head of the city laboratories at Syracuse, N. Y., and is succeeded by Dr. Augustus J. Gigger, formerly bacteriologist for the Rhode Island State Department of Health.

The firm of Waddell and Son, which has offices in Kansas City and New York City, has recently become incorporated. The new firm of Waddell and Son, Inc., includes, besides Dr. J. A. L. Waddell and N. Everett Waddell, their former assistant engineers, F. H. Frankland, Shortridge Hardesty, and L. C. Lashmet.

At a recent meeting of the scientific staff of the Bureau of Biological Survey, U. S. Department of Agriculture, Dr. C. Hart Merriam, founder and former chief of the bureau, now consulting biologist, U. S. Department of Agriculture, and research associate on the Harriman Foundation, Smithsonian Institution, delivered an address on the "Origin and Early History of the Biological Survey."

Professor E. V. McCollum, of the Johns Hopkins University, on April 12 addressed the Chicago section of the American Chemical Society on "The Biological Analysis of Food."

A meeting of the Botanical Society of Washington was held at the Cosmos Club, Washington, D. C. on April 2. The program was "The Grain Sorghums: The Botanical Grouping of Cultivated Varieties" (with lantern), by C. R. Ball; "The Shaw Aquatic Gardens" (with lantern), by F. V. Rand.

The first "Silvanus Thompson Memorial Lecture," founded by the Röntgen Society, London, in memory of its first president, was delivered by Sir Ernest Rutherford on April 9.

The annual meeting of the American Association of Museums will be held at Springfield, Mass., on May 20, 21 and 22.

The Council of the Southern Society for Philosophy and Psychology has decided, on account of the general situation and of the number of members of the society who are engaged in various forms of national service, to abandon the annual meeting scheduled to be held at Peabody College, Nashville, this spring.

The committee on botany of the National Research Council urges throughout the country to aid in securing data in reference to important crop diseases. In connection with what may be called the "barberry campaign," the following information is desired from as many regions as possible: (1) prevalence of barberry, (2) amount of infected barberry, (3) the neighboring grass flora, (4) amount of back rust on these grasses, (5) proximity of infected barberry and grasses to grain fields, (6) relative susceptibility of the different varieties of barberry (including *Mahonia*). Such information should be reported to Professor E. C. Stakman, University Farm, St. Paul, Minn., who will organize and distribute the data.

UNIVERSITY AND EDUCATIONAL NEWS

Several gifts and bequests were announced at the recent meeting of the corporation of Yale University. Mrs. James Wesley Cooper, of Hartford, has given $5,000 for the establishment of a publication fund in memory of her husband, who graduated from the college in 1865, and who was a member of the corporation for over thirty years. The widow of the late William A. Read, of New York, has made a memorial gift of $5,000 to assist the work of the Yale University Press. Two bequests have been received, one of $10,000 from the late Samuel J. Elder, '73, for the college, and one of $5,000 from the widow of Amory E. Rowland, '73 S., for the benefit of the Sheffield Scientific School.

It is stated in *Nature* that an anonymous donor has given Oxford University £500 towards the fund for the endowment of the professorship of forestry, and that the University of Liverpool has recently received a gift of £2,000 from Mrs. and Miss Holt as a

contribution towards the cost of equipment of the new department of geology.

Harold Ernest Burtt has been appointed instructor in psychology at Harvard University.

The first incumbent of the newly founded chair of phthisiology at the University of Edinburgh is Sir Robert W. Philip, professor of clinical medicine, said to be the founder of the first antituberculosis dispensary.

DISCUSSION AND CORRESPONDENCE

EVIDENCE FROM ALASKA OF THE UNITY OF THE PLEISTOCENE GLACIAL PERIOD

To the Editor of Science: In an article entitled "Frozen Muck in the Klondike District, Yukon Territory, Canada," by J. B. Tyrrell, of the Canadian Survey, published in the *Transactions of the Royal Society of Canada,* Series III., 1917, Volume XI., pages 39–46, there is a remarkable collection of facts seeming to prove the unity and continuity of the Pleistocene Glacial Period. It is true that there was no extension of moving glacial ice over the Klondike region, but there is abundant evidence of a change of climatic conditions corresponding to that of the generally glaciated region of the continent. During the warmer climate of the Tertiary period the streams had built up extensive gravel deposits over the bottoms of many of the valleys. For a long period "the climate had been temperate, or at all events, not arctic, and large numbers of animals, such as bison, mammoth, elk, moose, horse, etc., had roamed over the country.

Suddenly, a new set of climatic conditions began to prevail. The Glacial Period began, and, while the vast sheets of ice which covered so large a portion of Canada during that Period never extended over the Klondike district, the cold undoubtedly became very intense, and as a consequence the ground became permanently frozen. With the freezing of the soil and of the underlying rock the processes of oxidation and disintegration of this rock were no longer possible, and the small tributary brooks which flowed over the frozen land into the main streams were no longer able to collect and wash down sand and gravel from it. The supply of sand and gravel having been thus cut off, it could no longer be distributed by the main streams over the alluvial flats as it had been distributed before, but nevertheless the sand and gravel flats themselves were not worn away by the streams as they would have been under normal conditions, for they were cemented into very resistant masses by a matrix of ice.

The sand and gravel so deposited and preserved on the alluvial flats is now overlain by a deposit of vegetable material locally known as "muck," which may have a thickness of ten, twenty, thirty, or even as much as one hundred feet. The plane of separation between the gravel and "muck" is usually sharp and well defined, though occasionally little layers of "muck" may be found included in the upper beds of the gravel. The general impression that a person gets from a study of the deposits, however, is that of a sudden change from gravel to "muck" (pp. 40, 41).

The significant thing is that this layer of muck whose formation started in a period of great cold in early glacial times, has gone on continuously and uninterruptedly accumulating down to the present time. The bones of the extinct animals above enumerated "are found in large numbers in the underlying gravels and in the bottom of the muck; but the climate would seem to have soon become too inhospitable for them, and their remains are very scarce in the higher portions of the muck and finally disappear from it altogether" (p. 45). Dr. Tyrrell believes "that a critical study of the plant remains from the various layers of the muck might furnish much interesting information as to the character and climate of that portion of the world, in which there has been a continuous formation of vegetable beds from the beginning of the Glacial Period down to the present" (p. 46). The bearing of all this upon the unity of the Pleistocene Glacial Period is too evident to need statement.

G. Frederick Wright

Oberlin,

DRAWINGS ON LANTERN SLIDES

It often occurs that one wishes to interpose diagrams or line drawings in a classroom lecture which is being illustrated by lantern slides, and one has to either forego the point entirely, or turn on the lights and use a chart, or put the necessary diagram or

drawing on the blackboard. In the first case the good teacher usually feels there is a failure of full elucidation on his part, while in the second case valuable time is lost, and a break is made in the lecture.

To overcome this difficulty the writer recently devised a simple plan to make line drawings and diagrams on glass slides to be used as regular lantern sides. Clean lantern slide covers are taken, and on them the objects desired are drawn with a "china marking pencil." One must not lift the pencil from the glass while drawing, or else use great care at the points where the pencil is lifted and the same line then continued. It is not necessary to make an absolutely black line, as any mark shows plainly. A few trials will show how sharp one's pencil should be for the best results. As wide a margin must be left as in making ordinary slides. If a mistake is made it can be erased with the finger or a blunt piece of wood. The mark does not rub out too easily, consequently the slides can be used without the further trouble of covering if they are to be of a temporary nature. However, they can be fixed permanently by finishing them in the usual way with a clean cover slip and bound with tape.

As the "china marking pencils" come in at least three colors, black, blue and red, and as their cost is slight (15 cents) and the whole process is simple and short, their use in this way is practicable and inexpensive. The pencils can be purchased at any good stationery store.

HORACE GUNTHORP
DEPARTMENT OF BOTANY,
UNIVERSITY OF MINNESOTA

A SUGGESTION FOR MAKING THIN SECTIONS FOR BRYOZOAN SLIDES

IN making thin sections for bryozoan slides it has been noted by the writer that many of them have a frosty, crystalline appearance when they have been ground to the desired thickness. In the process of grinding, numerous small particles of calcium carbonate are forced into the openings, obscuring the structure. As these fine particles have relatively large surface exposure, they will dissolve much more readily than the rest of the fossil when treated with dilute hydrochloric acid. It is best to let the acid act for only a very short time and then wash it off quickly, repeating the treatment several times, if necessary, until the structure stands out clearly.

CHARLES E. DECKER
UNIVERSITY OF OKLAHOMA

A NATIONAL FLORAL EMBLEM

Now that America is engaged in the grim business of war for the defense of democracy, we are tempted in our zeal to forget the things which are purely sentimental because of the pressing needs of the things practical.

But with the dreaded arrival of casualty lists, the great heart of the nation has been deeply stirred, the grief of America stands in yearning need of sentiment. And so sentiment—pure sentiment—sponsors the thought that the American people have a real need for a recognized national floral emblem.

When the cherished day of peace arrives, how shall we greet our boys returning from the front? With flowers? Of course, but how with flowers? Goldenrods? Daisies? Violets? Yes, with all of these, but national sentiments might well be crystallized on a single national symbolic flower.

The rose of old England, the Fleur-de-lis of France, the thistle of Scotland, the chrysanthemum of Japan; all these remind us that America at present does not possess a floral emblem to epitomize the things that are noble and good in the nation.

Why should not all that is best in the American nation be symbolized in a flower as a national emblem? The very mention of such a symbol should stir the depths of patriotism in the breast of every true American. Surely Germany is the loser by not having a well-known floral emblem. In Europe, America has been criticized for being too material—would not the adoption of a national flower be an esthetic step in the right direction?

If, then, it is agreed that America will be benefited by possessing a recognized national floral emblem, the selection of a suitable flower is a difficult task indeed. The flora of the country is so rich that the choice

is large and rendered especially difficult because many plants have each their host of earnest admirers and advocates. In the mind of the writer, a national flower should have certain definite characteristics which are here outlined.

First, it should not be a troublesome weed in any sense of the word. A plant symbolic of our national glory should not be one that pesters and troubles the farmer; such a plant would fall far short of attaining the desired object.

Second, the plant should be native and fairly common in all parts of the country.

Third, a national flower should be easy of cultivation in all regions of the United States.

Fourth, such a plant should possess grace and beauty of both flower and leaf.

One flower, in the opinion of the writer, stands out preeminently as meeting all of these conditions very closely; that flower is the wild columbine. Our native flora can boast of no more handsome or more graceful member than the beautiful columbine. It has much to commend itself strongly to the advocate of a national flower; its graceful, nodding flower and exquisite foliage presents an eloquent plea for the adoption of this gem of nature as a symbol of American ideals. The columbine is native, has never been known as a weed and exists in every state in the Union. In all altitudes may this plant be found, from the peaks of the Rocky Mountains and the highest altitudes of Virginia, to the low lands of the coast. The columbine is easy of cultivation in all parts of the country—thus it fulfils the conditions for the ideal national flower.

And as though to further fulfil requirements, the columbine flowers from April to July, being thus present in its greatest glory on the two occasions when a national floral emblem is most desired, Memorial Day and the Fourth of July.

Again, the American eagle holds a place in the affection of America not shared by any other fowl or beast. The generic part of the scientific name of columbine, *Aquilegia canadensis*, was applied by the great Linnæus because of the resemblance of the spurs of the flower to the talons of an eagle; the Latin name for eagle is *aquila*. The conspicuous floral color is red, one of the three national colors, although the throat of the flower is yellow. The Colorado columbine is blue.

The columbine possesses five petals, a character which could readily be considered as corresponding to the five points of the star on the national ensign. Furthermore, the five spurs of the petals are grouped around a central floral shaft, suggestive of the relation of the states to the central government. The leaves are usually thrice-divided, which could be considered commemorative of our three martyred presidents, Lincoln, Garfield and McKinley.

In order that any plant be universally recognized as the emblem of the nation, it is necessary that the national government take action and render the selection official. Many of the states have already adopted state flowers, and who will say that these states have not been benefited by their actions? One state, Colorado, has already selected the columbine as the floral emblem of the commonwealth. In the advent of action by the national government, a word of warning should be heeded. When a plant becomes well known, there is created a tendency toward the extinction of that species because of the abnormal demand thus created. When Bryant eulogized the fringed gentian, little did he realize that his words would cause such interest in the beautiful flower, that eager misguided collectors would practically exterminate the fringed gentian in many regions. The adoption of the Oregon grape as the state flower of Oregon resulted in its practical extermination in the vicinities of the large cities and the plant became increasingly scarce all over the state. The adoption of a national flower would create demands that should be met in a sane and reasonable manner, or the selection might spell the doom of the favored plant.

A native plant of undoubted grace and beauty, the columbine seems to be the natural selection as an emblem of all that is noble,

chivalric and good in the character of the nation; an inspiration to all true lovers of liberty and justice and a symbol of the ideals of the American people. ALBERT A. HANSEN

WASHINGTON, D. C.

TRANSLATIONS MADE ACCESSIBLE

SCIENTIFIC papers written in some of the foreign languages present few difficulties to large sections of the scientific public, but translations are frequently desirable and sometimes essential. In the past such needs have been supplied by individual initiative and certain papers have been translated time and again. In these days when waste is more nearly criminal than foolish, and cooperation so easy, it should be possible for a worker who needs a translation of a given paper to find out whether or not such a thing is already in existence among his fellow workers before he starts the job anew. And if it is he should be able to secure a copy by paying for the necessary typewriting.

In place of following the somewhat customary plan of making the suggestion and commending it to the attention of this or that organization, the writer has started the compilation of a card catalogue showing the location of manuscript and published translations of books or papers on geology and paleontology and is willing to undertake the expansion of this catalogue to include all translations of papers in these sciences. To do this will require the cooperation of all persons or institutions possessing manuscript translations.

In return the writer will be glad to answer all inquiries regarding existing translations of specific books or papers and will furnish the names of persons or institutions willing to furnish copies of translations in their possession. He can start this at once, and already has records of nearly a hundred, though the value of the service will increase with the addition of new lists of available translations.

The writer realizes that these translations will not maintain a single standard, but he is certain that with few exceptions they will be valuable, and hopes to have the cooperation of his colleagues in making them all available.

Lack of time and the present-day need of hewing to a line necessarily limit this catalogue to papers on geology and paleontology, but the writer is ready and willing to turn over his data to any organization wishing to adopt the scheme in its entirety.

The working of the scheme is perhaps best illustrated by the following reply postal card, which has already been forwarded to the members of the geological and paleontological societies and will be sent to any one else on request:

REQUEST POSTAL CARD

N. B.: Please fill and forward as soon as possible.

Authors and titles of translations of papers in geology and paleontology which I am willing to share with other workers on the basis of their reimbursing me for actual cost of making typewritten copies.

(Space here for list, giving authors, titles and numbers of MS. pages.)

N. B.: Don't hold this card until you have occasion to use the space below; another card will be sent you by return mail.

Have you record of a translation of a paper by .... entitled .... published in ....

I am in no special hurry for this and will wait .... to join any one else, or will join any one who has been waiting, in order to secure a copy of this translation at the reduced rates made possible by the use of carbon copies.

In the event of your receiving .... other requests before .... for translations of the above paper I should be willing to share pro rata in the cost of having it translated.

In the event of your having no record of this translation please keep this request on file.

Name ....

Address ....

REPLY POSTAL CARD

The paper by .... has been translated and a copy can be secured by addressing .... The manuscript covers ...... pages and the approximate cost of a typewritten copy will be $.......

The paper by .... has been abstracted or reviewed in ....

Some who are in no special hurry for the translation you ask for are waiting to join others in order to secure the reduced rates made possible by

the use of carbon copies. Do you care to join them? ....

We have no record of the translation of the paper by ....

In accordance with your request we will keep your application on file.

If the requests for this translation number .... or more before .... (date) .... (no.) ...... others have agreed to share in the cost of having a translation made. Do you care to join them? ....

Are you willing to translate the paper or see that it is translated on this basis? ....

.... has agreed to translate this paper and to forward a copy to you.

This scheme of exchanging translations of papers in geology and paleontology is described in SCIENCE for April 12, 1918. It is available to all and depends for its success upon your co-operation. LANCASTER D. BURLING

GEOLOGICAL SURVEY,
OTTAWA, CANADA

SCIENTIFIC BOOKS

Chemical Analyses of Igneous Rocks. Published from 1884 to 1913 inclusive. With a critical discussion of the character and use of analyses. By HENRY STEPHENS WASHINGTON. U. S. Geological Survey, Professional Paper 99, Washington, 1917.

The Quantitative Classification of igneous rocks is one of the many very important contributions which America has made to the science of geology. As is well known it is the product of the labors of four distinguished petrographers—Professor Iddings, Professor Pirsson, Dr. Whitman Cross and Dr. H. S. Washington—and is based on the chemical composition of rocks rather than on their mineralogical character which formed the basis for the various older classifications.

In the earlier years of geological science but little attention was paid to the chemical composition of rocks, except in a very general way. Later when the chemical analysis of rocks came to be more common, the analyses were carried out in a very careless way since the rocks were considered to be merely aggregations of certain minerals the relative proportions of which might vary more or less, and, consequently, the chemical composition of the whole would be represented with sufficient accuracy even although an error of a per cent. or two in any one or other of the chemical constituents might be made. Now, however, the study of these igneous rocks is regarded as a study of silicate solutions and their equilibria and the subject has thus become a special branch of physical chemistry. Such being the case the accurate chemical analysis of igneous rocks is recognized to be of the greatest importance, and the correct understanding of the composition of these rocks is now seen to have a very far-reaching and important bearing on some of the most fundamental problems of the science.

As the importance of the chemical composition of rocks became increasingly recognized, attempts were made to collect and correlate all published analyses. The most notable of these was that of Justus Roth whose "Tabellen" of rock analyses were published by intervals between 1869 and 1884, and the more recent collection of A. Osann.

The present work by Dr. Henry S. Washington of the Carnegie Institution, Washington, goes far beyond these. Every serial whether published by a Survey, Society, or other organization, which might conceivably contain petrographic material, has been examined volume by volume, the examination embracing publications from the year 1883 to 1915. As all the analyses of importance published before 1883 had already been collected by Roth and are embraced in the present list—and as Dr. Washington has spared neither time nor effort to include in his paper all analytical material which is worthy of consideration—the present collection of analyses may be said to be complete, perfect and final. To use a colloquial expression the volume under review is "the limit."

The total number of analyses tabulated by Dr. Washington amounts to no less than 8,602, and it is significant of the increased interest taken in rock analysis in recent years to note that in the thirteen years from 1901 to 1913 inclusive, nearly twice as many analyses were published as during the sixteen preceding years between 1884 and 1900. This accounts

for the great increase in size of the present volume as compared with that of Professional Paper 99 which appeared from the pen of Dr. Washington in 1903, and which contained the analyses published up to that date.

Not only has the number of analyses published in recent years increased but the quality of the analyses has improved greatly—this may be seen if the more recent analyses are critically examined by the standards set forth by Dr. Washington, and it is especially noticeable that the quality of the analyses published in the United States, Great Britain, Canada, Australia and France, is now excellent, while the German analyses show a dead level of mediocrity.

This improvement is to be attributed in no small measure to the influence of Dr. Washington himself, since in his papers he has continually pointed out and insisted upon the necessity for greater care and thoroughness in rock analysis. In Dr. Washington's book on Mineral Analysis, improved methods especially adapted to the analysis of rocks have been described and explained. It may be mentioned in this connection that within the last few months his remarkable skill as an analyst of this class of materials, has been put to very practical account in connection with the striking investigations which have been carried to such a brilliant conclusion by the staff of the Geophysical Laboratory at Washington, in the manufacture of optical glasses required for the use of the United States Army and Navy. All of these glasses before the war were imported, for the most part from Germany, but now as a result of these researches they can be, and are being, made in sufficient quantity for the requirements of the service, under the direction of these gentlemen, in certain factories in the United States, a new industry having thus been established in this country.

The analyses assembled in this great collection are arranged in their proper order, according to the position of their "norms" in the Quantitative Classification. In each case not only is the analysis itself reproduced, but the "norm" is also given (the "norms" of the whole 8,602 rocks having been re-calculated and verified by Dr. Washington), as well as the locality, analyst, literature reference, and the name by which the rock is described by the author.

The analyses are arranged in four parts. Part I. embraces the "Superior Analyses of Fresh Rocks" and makes up the greater part of the volume. This is followed by Part II., which includes the "Superior Analyses which are Incomplete through the Non-determination of Some One or More Constituents." Part III. sets forth the "Superior Analyses of Weathered or Altered Rocks and Tuffs," while in Part IV. are gathered "Inferior Analyses" embracing those which are poor or bad.

The only errors to which attention is called are on p. 720, where in the Jacupirangite of Brazil the silica content should be given as 38.38 per cent. instead of 58.38 per cent. and on p. 1197, line 2, left column, where the caption British Guiana is omitted.

An excellent description of the Quantitative Classification itself, a tabular presentation of the divisions of names of the Quantitative Classification, the method of the calculation of the norm, together with tables of the molecular numbers and of the percentages of the norm molecules, are presented in five short appendices. It would subserve a very useful purpose if these appendices were reprinted separately, since they could be used much more readily in the form of a pamphlet of 30 pages than as part of the present massive tome embracing 1,200 pages. The reviewer hopes that the authorities of the United States Geological Survey will view favorably the suggestion that these appendices be issued as a separate paper.

Geologists will look forward to the discussion of "The Distribution of Magmas" and "The Average Rock" which are to be made the subjects of separate papers by the author, to appear later.

The excellent indexing of the volume and the high character of the press work are worthy of especial mention.

It is a volume which must find a place on the shelves of every petrographical laboratory in the world.

A lighter touch is given to this somewhat weighty subject—a connecting link with more transcendent things—by the text which appears in the upper corner of the page of preface. This is taken from Deuteronomy XXXII. 31, and reads as follows:—

For their rock is not as our rock, even our enemies themselves being the judges.

Certainly if the opponents of the Quantitative Classification have visited upon them the fate set forth as awaiting their representatives in the context of this passage from the Song of Moses, the Quantitative Classification of igneous rocks will be firmly established for all generations.

Frank D. Adams
McGill University,

A REVIEW OF SOME PAPERS ON FOSSIL MAN AT VERO, FLORIDA

In the number of the *American Anthropologist* for the first quarter of 1918 the writer is publishing a paper which deals with the discovery of Pleistocene man in North America. In that paper notice is taken of the literature which had appeared up to the time of writing it on the finding of human remains at Vero, Florida. Since then other articles on the subject have appeared, and I feel constrained to review briefly some of them. One of these papers is the official account of Dr. Hrdlička.[1] The gist of this account is found in these words:

The only satisfactory explanation of the conditions can be found in the assumption that the remains are those of intentional burials.

Naturally, this means satisfactory to the writer of the report; for six other men have furnished explanations on the same subject, each apparently satisfactory to its author, and all differing much from that of Dr. Hrdlička. At least three of those six men are experts in the solution of geological problems, but not one of the six sustains Dr. Hrdlička in his theory of intentional burial. Meanwhile he hardly attempts to remove the difficulties which beset his assumption. His method may be defined as the easy one of solution by fiat.

[1] Rep. Sec. Smithson. Inst. for 1917, p. 10.

Three papers on the same subject appear in the *Journal of Geology* for October–November, 1917. They are the outcome of a week's collaboration and consultation at Vero on the part of Drs. E. H. Sellards, R. T. Chamberlin, and E. W. Berry. No comment is here made on Sellards's paper; for, so far as Sellards has expressed himself, the present writer is in accord with his views.

Dr. Berry's paper deals especially with the fossil plants found in the muck bed; but he discusses other important matters. He concludes that the muck deposit and, of course, the stratum of sand beneath it, belong undoubtedly to the Pleistocene; that the human remains were not buried intentionally; and that man lived there contemporaneously with the extinct vertebrates. He generously excuses Dr. Chamberlin's theory of the in-wash of the fossil bones and Dr. Hrdlička's theory of intentional burial on the ground that the age of the extinct vertebrate fauna had been overestimated. It is to be regretted if these experienced men were constrained to resort to desperate measures in order to save their anthropological theory.

It seems to the writer that Berry assumes to be true too many debatable matters. He says that the shell marl which underlies the other beds at Vero is late Pleistocene in age; and he bases this statement on the asserted fact that its species all now exist in near-by waters. Mansfield's list of mollusks[2] does not exactly support this statement. There are more than a dozen species about which there is doubt of one kind or another. Furthermore, if the molluscan fauna were not essentially that of Recent seas the beds would have to be assigned to the Tertiary.

Again, Berry takes it for granted that the lowest and youngest terrace, the Pensacola, is of late Pleistocene age; but this view lacks confirmation. This terrace is supposed to continue northward into the Talbot of Maryland and thence into the Cape May of New Jersey. The present writer is not inclined to question the conclusion of Salisbury and Knapp that the Cape May was coincident with the Wis-

[2] Ninth Ann. Rep. Fla. Geol. Surv., p. 78.

consin; nor that the Talbot represents about the same period of time. Both of these formations are singularly destitute of vertebrate fossils. On the other hand, the lowest terrace in Florida, Georgia, and the Carolinas is filled with remains of extinct vertebrates down to salt water. At Wilmington, N. C., the great sloth *Megatherium* and horses are found. The latter occur all along the coast of North Carolina, along the Potomac, and on the west shore of Chesapeake bay. The line of horse-bearing localities is then taken up at Swedesboro, N. J., is continued past Philadelphia, and ends at the Navesink Hills. From the Potomac to Raritan bay it keeps far away from the Atlantic coast. In the Fish House clays, opposite Philadelphia, considerable horse remains have been found. By the New Jersey geologist these clays are regarded as belonging to the Pensauken formation; and this is referred to the early Pleistocene. The vertebrate fossils appear, therefore, to connect the lowest terrace of the south Atlantic states with the Pensauken, rather than with the Wisconsin. Berry's admission that the Vero deposits may be as old as the Peorian shows that he does not believe that any connection with the Wisconsin drift has been established.

The writer contends likewise that the Pensacola terrace has not yet been geologically correlated in the Mississippi Valley with any definite glacial stage.

Inasmuch as Berry grants that the Pensacola terrace may be as old as the Peorian interglacial stage he and I need have no quarrel about the age of the Vero muck bed. He may perhaps yet come to acknowledge that it may be as old as the Sangamon.

As regards Dr. Chamberlin's paper it may be stated that he has decided to abandon his theory of the secondary inclusion of the vertebrate fossils—"unless all other explanations fail." He asserts (p. 667) that the dates of the appearance of man and of the disappearance of the extinct animals were among the very points brought into question and could not themselves be used as decisive criteria. With that part of this statement which concerns man I agree; but with that which regards the vertebrates I dissent. The time when those vertebrates lived and when they disappeared is to be determined by their relation to the deposits in which they have been found in a thousand or more other places in our country; and it is legitimate to apply the knowledge gained therefrom to the situation at Vero. Chamberlin seems to respect rather lightly the vertebrate fossils, for he believes that the time relations of the deposits were quite well indicated by the physical criteria, irrespective of their fossil contents. He believes, with Berry, that the marine marl bed and with it the Pensacola terrace is late Pleistocene in age. The writer takes this occasion to say that if the geologists can prove that proposition it will at once end the dispute about the time of the disappearance of the fauna represented at Vero; and vertebrate paleontology will become once more indebted to geology. Pending that proof I shall maintain, on the evidence of the vertebrate fossils, that that terrace belongs to the early third of the Pleistocene.

Dr. Chamberlin's faith in the value of fossils seems to be somewhat livelier when, in order to determine the age of the human relics at Vero, he cites the age of European pottery and men's bones; but what connection has been established between the use of pottery in Europe and its use in America?

It is not a little amusing to observe that the camels and horses and their fellows, which under the designation of a "Pliocene fauna" were used at Table Mountain to combat the existence of early man, are now, at the other, far distant, end of the line, mustered in as a "mid-Recent fauna" and called into service to continue the same war.

OLIVER P. HAY
CARNEGIE INSTITUTION OF WASHINGTON

SPECIAL ARTICLES

THE ANIMAL CENSUS OF TWO CITY LOTS

ASIDE from articles by McAtee, Banks and Herbert Osborn,[1] very little attention has

[1] McAtee, W. L., "Census of four square feet," SCIENCE, Vol. 26, pp. 447–49, 1907; Banks, N., "A 'census of four square feet,'" SCIENCE, Vol.

TABLE I

Animal Population of Areas of .518 Sq. Ft.

Date	Slugs	Earthworms	Millipedes	Centipedes	Sowbugs	Mites	Spiders	Thysanura	Orthoptera	Homoptera	Hemiptera	Lepidoptera	Diptera	Hymenoptera	Coleoptera	Miscellaneous	Total Insects	Total Animals	Lot
September 25......		1										1	1	49	3		54	55	Green
September 26......						2	3			6			3	2	2		13	18	Green
September 26......		2				1	3				1	1		2	3		7	13	Green
October 2.........					2		6			8	1			9	4		22	30	Green
October 2.........					4	2	4			9		3		2	4		18	28	Green
October 5.........		26	3		10		2			2		1			1		14	45	John
October 5.........	1	19	3		12		3			7					1	2*	10	48	John
October 5.........		7			6		1			1				2	3		6	20	Green
October 6.........			1		5		2			1	1	3		2	2		9	17	Green
October 6.........		8			1		1			2	7		1	3	5		18	28	Green
October 11........					4	1	3			6				3	9	58*	76	84	Green
October 11........	2	2	1		7		8	1		8	2			4	8		23	43	Green
October 11........			3							53	3			7	5		68	71	John
October 13........		6										1		1	1		3	9	Green
October 25........	1	3			11		1		38*		2				4		44	60	Green
October 25........		2	2		1		1				1	1		1	2		5	11	John
October 25........	2	2			8		12	1		2	2	1		1	4		11	35	Green
October 27........		3			3		2			2		2			4		8	16	Green
October 27........		8	3	1	3	1	5			10	1	9			11		31	52	John
October 31........	1	1				3	2						1	1	37		39	46	John
October 31........		4	1		8		1			1		10			6	1	18	32	Green
November 1.......		11					2				1			1	2		4	17	Green
November 1.......		7			2	1	5								2		2	17	John
November 3.......		3					3		91*	2		4			4		101	107	Green
November 3.......		6			8		1			44†	3			9	5		61	76	Green
November 3.......		1					38											39	Green
November 3.......		10		1	2		1			1		1		12	8		22	36	Green
November 6.......		17						1		1		3		1	12		18	35	Green
November 6.......		4										1			1		2	6	Green
November 6.......		4	3		1	1	5			1	1				4		6	20	John
November 9.......		4					2			49†	4			1	11	7	72	78	John
November 10......		5			2		5							5	2		7	19	Green
November 10......		5		2	23	1	9	15	12*	49†	4	1		1	16		98	138	Green
November 17......							5			1		4			2		12	12	John
November 27......		3		1	10		4	2		18					7		27	45	Green
November 27......		1		1			1				1				5		6	9	John
November 29......		3					6			2	2	4			17		25	34	Green
December 1.......		8			3	1	3	4		3	1	2			24		34	49	Green
December 1.......		3					10	1			3	2			3		9	22	John
December 6.......		4					4	12		17		3	4		2		38	46	Green
January 7.........	(Ground frozen)					1	2				2				2		4	7	Green
January 7.........	(Ground frozen)						2				1		4		8		13	15	John
March 22..........		6	2		1		5				2				4		6	20	Green
March 22..........			1						83*						8		91	92	John
March 30..........		12			21		2				2	2			3		7	42	Green
March 30..........		4	1		1	3			107*						2		109	118	John
April 10..........	1	43			1		1			158*					5	2	165	211	Green
April 10..........		9	4	5	15	7						1		5	9		15	55	John
April 11..........		19			22		2			87*	1	1	2		5		96	139	Green
April 11..........		10					2					3			3		6	18	John
April 12..........		22			5										4		4	31	Green
April 12..........		3	4		4	5	1		112*	4		2	1	96	1		216	233	John
April 17..........		13			5		1							2	6		8	27	Green
April 17..........		4	3	1	38	2	2	1			1	6		1	19		27	83	John

TABLE I (*continued*)

Date	Slugs	Earthworms	Millipedes	Centipedes	Sowbugs	Mites	Spiders	Thysanura	Orthoptera	Homoptera	Hemiptera	Lepidoptera	Diptera	Hymenoptera	Coleoptera	Miscellaneous	Total Insects	Total Animals	Lot
April 18		10		2	6	1	2	2		1	1			1	7		12	33	Green
April 18		21	3	3	23	4	4	3				2		6	6		17	75	John
April 23		15			5	1	1					3	2	4	1		10	32	Green
April 23		6	2		3										2		2	13	John
April 26		7			6		3	5			1			2	3		11	27	Green
April 26		11	1	3	31	2	2	1			1				8		10	60	John
May 10		11			5	1	1					1			1	3	2	23	Green
May 10		8			16	1	4	3			1	3	1	1	5		14	43	John
May 14		19	1	4	17		1	4						1	5		10	52	Green
May 14		8	2	1	42	2	5	4			2	2			3		11	71	John
May 15		7		2	8			3			1			9	2		12	32	Green
May 15		14	5	1	11		4				2	2			1		5	40	John
May 17		4	3	1	14	2	1			2		1		11			14	39	Green
May 17		2	6		2		1			1	1	3		20	1		26	37	John
May 18				1	15	1	2		3*		2	3		7	8		23	42	Green
May 18					4		3			1	1	1		42	2		47	54	John

* Indicates eggs. † Indicates partly eggs.

been given to the total animal population of definitely measured areas of land. At the suggestion, and with the aid and assistance, of Dr. V. E. Shelford, of the University of Illinois, a study was made of the animal population of two vacant lots, a block apart, in Champaign, Illinois, over a period from September, 1916, to May, 1917. The lots were on John and Green Streets, adjoining the Illinois Central Railroad. They had not been burned over for at least a year, and despite the encroachments of débris from the railroad and nearby houses, were essentially wild, being covered with grass, sweet clover, dandelions, burdocks and other weeds, while the Green Street lot had a thicket of young honey locusts on one side, and that on John Street had a brook bordered by osage orange and willows running along one side.

The apparatus used was very simple, consisting of a tin pail with the handle and bail removed, and a screw top, an inch in diameter, soldered into the bottom, through which the anesthetizing agent could be introduced. The sharp edges of the pail, where the bail had been cut away, would sink into soft earth, and with the aid of a big knife, vegetation and hard earth could be cut through, so that the animal population of that small area would be imprisoned in the inverted pail. A considerable amount of chloroform or ether was added through the screw top, and after clearing away the surrounding vegetation and débris, sufficient time would have elapsed so that all the active animals were anesthetized and the pail could be taken up without fear that any of them would escape. The vegetation within the circle was picked to pieces and shaken over newspapers, weed stems split up, the surface of the earth left bare was carefully examined and finally all the earth to a depth of six inches was dug up and sifted over newspapers, so that all animals large enough to be visible to the naked eye would be sorted out. The surface area covered by the pail was .518 sq. ft., which, multiplied by 84,092, gives the population per acre. Two examinations (one for each lot) were made daily when time was available, or the ground not too wet and sticky or frozen. The results are given in the table.

The area enclosed by the pail (.518 sq. ft.) is so small that there will necessarily be a wide

26, p. 637, 1907; Osborn, H., "Leaf-hoppers of Maine," Maine Agr. Expt. Sta. Bull., No. 238, pp. 81–160, 1915.

TABLE II

Average Animal Population for Twenty-day Periods

Period	Earthworms	Millipedes	Centipedes	Sowbugs	Mites	Spiders	Thysanura	Orthoptera	Homoptera	Hemiptera	Lepidoptera	Diptera	Hymenoptera	Coleoptera	Total Insects	Total Except Insects	Total Animals
September–October	4.4	.8		3.6	.5	2.6			7.4	1.1	.7	.3	6.1	3.6	24	12	36
October–November	4.7	.5		3.5	.4	5.7		10.	4.8	.8	2.2		2.	7.6	26	16	42
November	6.1	.4	.3	3.7	.8	3.7	2.3	1.7	14.4	1.2	1.2		1.1	7.	31	13	44
November–December	3.7		.3	2.3	.2	4.3	3.2		6.7	1.2	1.8	.7		9.7	23	11	34
Winter:																	
March–April	12.8	1.2	.5	7.1	.5	1.3		30.2	24.9	.5	.9	.3	10.1	4.4	72	24	96
April	10.9	1.7	1.1	12.1	1.2	1.9	1.5		.1	.5	1.4	.2	2.2	6.5	12	32	44
May	7.3	1.7	1.	13.4	.7	2.2	1.4	.3	.4	1.	1.6	.1	9.1	2.8	16	26	43
Average	7.1	.9	.5	6.5	.7	3.1	1.2	6.3	8.4	.9	1.4	.2	4.4	6.9	29	19	48

TABLE III

Revised Animal Population

Period	Total Orthoptera	Orthoptera (One Egg-cluster Equals One Individual)	Total Homoptera	Homoptera (One Egg-cluster Equals One Individual)	Revised Total Animals	Revised Total Insects	Revised Total Except Insects	Animals per Acre	Insects per Acre
September–October			7.4	7.4	33	21	12	2,665,036	1,756,932
October–November	10	.1	4.8	3.	30	15	15	2,422,760	1,261,380
November	1.7	.1	14.4	3.	31	17	14	2,506,852	1,429,564
November–December			6.7	1.5	30	18	12	2,422,760	1,513,656
Winter:									
March–April	30.2	.3	24.9	1.	42	1	23	3,531,864	1,597,748
April			.1	.1	44	2196	32	3,700,048	1,009,104
May	.3	.1	.4	.4	43		27	3,605,956	1,345,472

variation in abundance in all orders of animals in any two examinations, and it is only by averaging results for twenty-day periods that some idea can be gained of seasonal variation.

The great unevenness in the Orthoptera and Homoptera columns is because each individual grasshopper or mealybug egg is counted as an individual. The result is to greatly increase the apparent total animal population in the fall and early spring. But when each cluster of eggs is counted as one individual, the Orthoptera become negligible and the Homoptera decrease in numbers from early fall, the resulting total animal population showing a very striking uniformity throughout each season.

The one third increase in population in the spring over that in the autumn is due, not to insects, but almost entirely to earthworms and sowbugs—the earthworms being most abundant early in the spring when the ground is moist, and going deeper than six inches as it later dries out, but the sowbugs become most abundant in May. Variations in the Hymenoptera column are due to occasional accidental selection for examination of a plot containing a nest, or near a nest of ants, but variations in the numbers of beetles, of which many species in greatly varying abundance were found, can not be assigned to any one cause. Considerable numbers of empty puparia were found, quite out of proportion to the small number of live Diptera. Thysanura were very abundant when weather conditions were just right, but Lepidoptera (mostly cutworms) and Hemiptera showed quite uniform abundance. The data as a whole show the preponderating abundance of earthworms, sowbugs, beetles, spiders and ants in this particular habitat.

George N. Wolcott

1539 Sunset Ave.,
Utica, N. Y.

SCIENCE

FRIDAY, APRIL 19, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A COMMON-SENSE CALENDAR

OUR present Calendar is merely a rough tool. We can readily calculate dates inside of each month, and with some figuring we can reckon a month or two ahead. But when we are called upon to connect the proper week-day with some date more than two months ahead or behind, scarcely one of us can perform the operation without reference to a calendar. Current-year calendars are generally accessible, but it is no easy matter to ferret out old dates. It is even more difficult to determine dates in future years. In short, our measuring scale for dates is faulty. Like the Roman numerals it is unsuited for any but the simplest problems.

Who, for example, can find out for himself on what day of the week he was born? On what day of the week was the Declaration of Independence signed, or the Battle of Waterloo fought?

If your lease expires October 1 (or May 1), and you have to move, in what part of the week will this happen? If you have a regular engagement the first Monday of each month, will it conflict with another engagement on the third of next month or the month after? What months this year have five Sundays? How many annoying mistakes have you made during your life in such calculations?

If a ninety-day note or a three-month note is to be paid, on what day of the week is it due? Some quarters are longer than others, making the exact reckoning of interest difficult. Weekly periods of earnings in one year are not exactly comparable with the corresponding periods in other years. Holidays, like interest days, fall on different week-days in different years—sometimes very awkwardly.

The lopsidedness of our calendar is due to the Emperor Augustus, who insisted that his month should contain as many days as the month of Julius Cæsar. As a matter of his-

THE NEW ERA CALENDAR

January		April		July		October
Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
[Y]	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	*	*	*	*

February		May		August		November
Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
*	*	*	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	*	*

March	June			September		December
Sun.	Mon.	Tue.	Wed.	Thu.	Fri.	Sat.
*	*	*	*	*	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	[L]	*	*	*	*	*

THE MONTHLESS OR EXTRA DAYS

[Y]—THE YEAR-DAY precedes January 1 every year.

Rule: Divide number of year by 7; if the remainder is 0, the Year-Day is Year-Saturday; if the remainder is 1, Year-Sunday, etc. (Example: In 1904 Year-Day is "Year-Saturday.")

1919—Year-Sunday	1922—Year-Wednesday
1920—Year-Monday	1923—Year-Thursday
1921—Year-Tuesday	1924—Year-Friday

[L]—THE LEAP-DAY precedes July 1 every fourth year (excepting the years 1700, 1800, 1900, 2100, 2200, etc.).

Rule: Divide number of year by 28; if remainder is 0, the Leap-Day is Leap-Saturday; if remainder is 4, it is Leap-Sunday; if 8, Leap-Monday, etc. But there are no Leap-Days in years divisible by 100 and not by 400. (Example: There is no Leap-Day in 1900; in 1904 Leap-Day is "Leap-Saturday.")

1920—Leap-Wednesday	1928—Leap-Friday
1924—Leap-Thursday	1932—Leap-Saturday

tory this is interesting. But is it fitting that the modern world should be put to serious inconvenience, merely to commemorate the glories of the Augustan age?

Several suggestions have recently been made for a reformed Calendar. The "New Era Calendar" is original, I believe, in one particular. It proposes to take the first day of the year (the Year-Day) and the extra day in Leap Year (Leap-Day) out of the regular order of week-days and make them up into *weeks of their own.* In this Calendar, Year-Day belongs to no month at all; it comes in between December 31 and January 1. In years exactly divisible by 7, the Year-Day is Year-Saturday, the next year it is Year-Sunday, etc. Leap-Day comes between June 31 and July 1 once in 4 years (except in century years). In years divisible by 28 it is Leap-Saturday, 4 years later it is Leap-Sunday, etc.

Thus in 1919 the first day of the year is Year-Sunday, in 1920 it is Year-Monday, and so on—though the thirty-first of December is Sunday every year and the first of January is always Monday. The extra leap-year day in 1920 will be Leap-Wednesday, in 1924 Leap-Thursday, and so on. But June 31 is always Sunday and July 1 is always Monday.

Attempts to standarize the calendar so that each date would always fall on the same week-day have hitherto met with considerable opposition from church authorities and devout persons of many different creeds. They insist on scriptural grounds that the seventh day must always be set apart as a day of rest and religious observance. The present scheme provides for this exactly. There are 52 Sundays (and Saturdays) in each year, with one additional Sunday (and Saturday) once in seven years, and one more Sunday (and Saturday) once in seven leap years. This seems to meet fully the requirements of the church and of scripture.

In other respects the New Era Calendar copies an earlier Swiss[1] proposal. It is simple.

[1] By L. A. Grosclaude, of Geneva. Virtually the same scheme has been worked out (perhaps independently) by several persons of different nationalities. Camille Flammarion proposed something

The table given here is good for *any year*. Two months of 30 days are followed by one month of 31 days, making 13 weeks in each quarter. January, April, July and October are *exactly alike*. The first day of these four months is Monday—it is the same in every year. The first day of February, May, August and November is always Wednesday, and the first day of March, June, September and December is always Friday.

Each quarter has exactly 91 days; the monthless days (Year-Day and Leap-Day), being holidays, may be left out of account in reckoning interest, rents, wages, etc. Birthdays, wedding anniversaries, holidays and other notable dates fall on the same day of the week every year. Election Day is always November 7; Inauguration Day is always Monday. A college or school which opens on (say) the third Tuesday in September would always open September 19. These are but a few of the many ways in which reckoning is simplified.

Any person of ordinary intelligence can readily find the day of the week for any date in any year according to this Calendar. In a few minutes one can learn to associate Monday, Wednesday and Friday with the proper months, and the rest is easy. Even a school-child could answer without difficulty such questions as were asked at the outset, though they effectually baffle most of us under the present system. The Gregorian Calendar has fourteen different yearly arrangements; each of these involves a table of twelve months. The New Era Calendar calls for only *one table of three months*. If we consider the table of extra days as doubling the complexity of our scheme, the New Era Calendar is still twenty-five times simpler than the Gregorian.

Among the reconstructions which will undoubtedly follow the war, would it not be worth while to adopt a common-sense Calendar?

HOWARD C. WARREN
PRINCETON UNIVERSITY

rather similar in 1884, but Monsieur Grosclaude seems to have been given the first definite formulation. (See *Journal suisse d'horlogerie*, 1900, *24* pp. 378–9, and table on p. 356; also note in *Revue scientifique*, 1900, 4ᵉs. *13*, p. 766, where the present writer first saw it.) Flammarion repeated his proposal in 1901 (*La Revue*, *37*, pp. 233–246). Alexander Philip proposed virtually the same plan in 1814. ("Reform of the Calendar," London: Kegan Paul, pp. 127.)

Several different schemes have also been suggested; *e. g.*, 13 months of 28 days each; and the matter was once discussed by an international commission. See also a number of communications in SCIENCE, 1910, *32*. The writer is unable to find that the idea of grouping the year-days into "year-weeks" has ever been suggested before.

CHEMICAL LITERATURE AND ITS USE

BUNSEN says, there are two distinct classes of men, those who work to enlarge the boundaries of knowledge, and those who apply that knowledge to practical uses. If we agree with a recent declaration that "chemistry is the intelligence department of industry," the modern chemist and particularly the chemical engineer, who is called on to answer all questions for every industry as well as know his own subject, needs to be aware of all possible sources of information.

Thus, a first-class chemist (including here the chemical engineer) must know and be able to use not books, only, but the periodical literature, journals, publications of societies and governments. He requires, then, a reading knowledge of German, with French if possible, and sufficient practise in English to enable him to make, both orally and in writing, a concise, clear report of work accomplished or planned, this being in addition to technical skill gained by training, and a liking for his work.

Specific training in this use of literature becomes a real problem where there are a number of students engaged individually in more or less advanced stages of research work, as seniors and graduate students.

Such training is given to a certain extent under various names, in a number of American technical schools and universities. Seniors are directed to find first what has been done on any problem assigned them. Even sophomores realize that the class texts are not the only books, while some join the American

Chemical Society and gain first-hand acquaintance with its journals. With a smaller number of students, we find, usually, limited library facilities, while, where more literature is available instructors have less time for individual direction of men to the sources of information.

Three years ago a brief study of current catalogs from about twenty institutions giving chemical courses similar to those at Illinois was made. From the data obtainable, the amount of work varied greatly. Meetings are held weekly, fortnightly, or monthly; attendance is for "any one interested"; for "graduate students and instructors"; meetings are "open to advanced undergraduates"; or attendance is "required of candidates for an advanced degree."

In only five of the institutions studied was there a definite statement as to credit given for the course. Case gave one hour, the second semester of the senior year; Ohio had a two-hour course second semester of junior year, required for chemists, but elective for chemical engineers. Michigan offered one to three hours, credit for senior chemical engineers, entrance to the course being by special permission; no statement of it for chemists was found. Massachusetts "Tech" required one hour a week the first semester for senior chemists, and two hours for senior chemical engineers. Chemists had to attend the instructors' journal club. Worcester Polytechnic Institute required a two-hour course the second semester for sophomores and a one-hour course all the junior year. None of these specifically stated training in use of the library as part of the course.

At Illinois, the existing junior journal course seemed to offer an opportunity for definite instruction and training in the use of reference books, abstract and review serials, and collective indexes, without adding an extra course to the well-filled schedule. Some account of the work so far and its results may be of interest; since several who looked it over at the April, 1916, meeting of the American Chemical Society have since used the outline, readings, lectures and problems, as a basis for similar courses elsewhere.

The journal course began as reports on recent numbers of foreign journals, at the first meetings of the Chemical Club in November, 1892. It appeared in the university catalog 1893–94 as "Chemistry 19. Seminary. Reports and discussions upon assigned topics from current chemical literature," with credit, and persisted as weekly or fortnightly meetings, being a prescribed course for juniors, seniors, and graduate students, with a few minor changes, till 1910–11, when a separate section for juniors was arranged, leaving seniors, graduates and instructors in the other section.

The revised journal-library course, now, as prescribed for all juniors in chemistry and chemical engineering, gives one hour credit each semester. It comprises study of the history of chemistry, chiefly biographical, based on the first volume of Kopp's "Geschichte der Chemie," with additional biographical papers in German or French. This gives opportunity for each student to make each semester two translations of fifteen to twenty pages, and two speeches. Then the twelve half-hour library lectures in the year, with problems for each one, give some practical experience in the actual use of books and serial publications. During the second semester the topics for translation are from current chemical serials, on recent important developments of the science. In 1915, 1916 and 1917, a summer school course was offered with lectures briefly covering the history of chemistry, and including class reports and all the library lectures, being considered as equivalent to either the first or second semester of the regular course according to the problems worked by the individuals.

The library lectures attempt to compel use of the books, works of reference and serials, in the chemistry library, by the students, so that they may at least know that such material exists and be able if called upon to utilize it. The lectures include explanation of the classification, catalog, and arrangement, of books; and serials; statements as to the fields covered

by the various works of reference; the general and special journals and society publications; discussion with explanation of the kind of information to be had in the different abstract, index and review serials; and information as to the best works available here in the several sections of chemistry, general, analytical, inorganic, mineral, organic, physiological, applied, theoretical, physical and colloid. The selection of these "best" works has been made or approved by the man who uses that section, before they are presented to the class for consideration. Frequent revision is of course necessary to keep the lists up to date. No parallel course is given elsewhere to my knowledge, and training of this kind has a money value, as well as does that in the laboratory proper, since many of the larger industrial plants have libraries and reference librarians, to help them keep up with current investigations and the effect upon their special problems. Little & Co., of Boston, is a good example.

Students are referred to what are the best, *i. e.*, most comprehensive and up-to-date books at any given time, and are compelled to some use of them. For example, some of the larger, important works at present, 1917, in the various divisions of chemistry at Illinois are:

Inorganic: Roscoe and Schorlemmer, edition four, 2 vols., and in German the Handbücher of Abegg and Gmelin-Kraut, edition 7, but both of these German texts are as yet incomplete, but have good bibliographies for the elements and the years they cover.

Organic: Meyer and Jacobson, "Lehrbuch," edition 2, has no equal in English, and the lack due to the fact that Vol. 2 has not come out may be supplied in part by the eleventh German edition of Richter's text-book, and in part by Hilditch's thirty-year course, in English, with Clarke's Introduction as a more elementary but modern work.

Analysis: Here is Treadwell, edition 4, 2 vols., for general, Gooch, Crookes and Classen for selected methods. Lunge in 6 volumes on technical, Allen in 8 for technical organic; for organic, Mulliken has at last got three volumes out with a promise of the fourth soon. Clarke's Handbook, and Weston on carbon compounds, are less comprehensive.

Biochemistry: Abderhalden's 10 volumes of methods are supplemented by Oppenheimer's volumes of general information. In English the series of monographs on biochemistry is being kept up and covers practically every topic.

Theoretical: Nernst, edition 7, in English is now available. Mellor's "Chemical Dynamics," and his book on mathematics for chemists, with Partington's are very useful.

Industrial: The newest books are old here as compared to the serials, but Martin's edition 2, Molinari and Sadtler, edition 4, do well for industrial organic. Molinari's inorganic industrial is a trifle old and Rogers, edition 2, does not include everything. The analytical texts have been mentioned and the number of special texts is great.

Of course, to do new work we must begin on the basis of present knowledge. It is assumed that the specialist will keep up in his own field, receiving publishers' circulars, and noting book reviews for new books. But given a new topic, or an unusual one, chemists should know how to find or at least where to search for what is known at present, quickly and surely. Here the organic chemist has an immense advantage, in the case of a known substance. Having the formula, Richter's "Lexikon" with its supplement will give him physical constants, the principal references to literature, and most important of all the page reference to Beilstein's "Handbuch," where he finds a concise careful summary.

Thus he has all information to and including 1911. The annual indexes of *Chemical Abstracts* and the *London Journal of the Chemical Society,* may be supplemented by the formula indexes, annual, of papers published in the *Annalen* and *Berichte.* Sometimes Abderhalden's "Biochemisches Handlexikon" is helpful, being newer than Beilstein and giving more information than Richter. If the substance is a coal-tar product, a dyestuff or the like, the volumes of Friedlaender's "Fortschritte" with subject indexes and collective indexes by German patent numbers, 1877 to 1914 inclusive, are invaluable. If the problem as processes or material is not listed under a special substance, Weyl and Lassar-Cohn give methods, in German of course. For preparations, adequate, brief and

timely, the organic volume of Vanino is the best at present and it gives plenty of references to original papers.

If these fail him, he, with the inorganic, physical and industrial man, must plunge into what librarians call the abstract and review serials, giving currently or for an annual period the literature with abstracts, and, in review serials, some critical discussion as well. There are many in English, German and French; perhaps a few suggestions may be of service—at least the plan has worked fairly, during a trial of six years with the senior graduate students and an occasional faculty member.

For rapid work, take those abstract serials in English first: when the ten-year collective index to *Chemical Abstracts* appears that will be for a time the best starting point. Barring that, take the annual indexes of the *Chemical Abstracts* or the *London Journal,* going back to the newest collective index of the *London Journal,* for 1903–12; then use these collective indexes, which take the literature back to 1841. If these articles and cross references are not enough, turn to Liebeg and Kopp's *Jahresbericht,* from 1847, but published so far only through 1910, and use collective indexes again. To insure finding everything, one may check by use of the collective indexes of the French *Bulletin,* 1858–1896, and *Chemisches Centralblatt;* the latter has no collective index published for 1880–96. For work done before 1847 there are two chief sources: (*a*) Berzelius's *Jahresbericht,* 1822 to 1850, with a collective index for the first twenty-five volumes; we have one also, made at Illinois, for the volumes 26–30; (*b*) the collective indexes of the *Annales,* 1789 to approximately 1870, when it ceased giving abstracts. For 1901 on, International Index to Scientific Literature: Chemistry, may give some references omitted by accident from the other lists, though it does not often happen. Supplementary too, are the collective indexes of the *Chemical News,* Vol. 1–100, and *Journal für praktische Chemie,* Vol. 1–100, but neither of these attempts to include all chemical literature. This list does not pretend to be complete, though the foregoing are enough in most cases, but some divisions of chemistry have excellent special publications; as, in agricultural chemistry the collective indexes of the *Experiment Station Record,* Biedermann's *Centralblatt* and Hoffmann's *Jahresbericht.* For industrial chemistry in general, the two indexes of the *Journal of the Society of Chemical Industry,* 1882–1905, the one, 1887–1907, of *Zeitschrift für angewandte Chemie* and two for Wagner's *Jahresbericht* for 1855–1894; here for dyes, explosives and coal-tar products in general the Friedlaender, noted for organic chemistry, is invaluable; biochemistry has a worthy rival to Beilstein and more up-to-date, in the indefatigable Abderhalden's "Biochemisches Handlexikon" and its supplement, ten volumes now, but without a collective index as yet; the *Biochemisches Zentralblatt,* dating from 1902, has only one collective index as yet; the most thoroughly satisfactory source for the time it covers is Maly's *Jahresbericht,* 1870 to date, though unfortunately the collective index for 1901–10 has not yet reached this country, if it has even appeared. For pharmaceutical chemistry, the 50-year Index to Proceedings, now continued as Yearbook, of the American Pharmaceutical Association, 1851–1902, is useful, as well as the collective and annual indexes of the *British Pharmaceutical Journal,* 1841 to date, and of the *American Journal of Pharmacy,* 1833 to date. The U. S., National-Standard, and the American Dispensatory, all give references, particularly to medical literature, not to be had elsewhere.

The work as offered seems in part to solve the problem, when the number of students is too large for individual instruction, and it has the advantage of calling to the students attention the literature in several divisions of chemistry, Seniors pride themselves on being able to find books on the shelves, as well as references for their own use. Some training is gained by presentation of the oral reports, since the outline for these is discussed with the instructor before presentation in class; the class furnishes a critical audience; notebooks are expected to contain date, topic, speaker,

reference, and some brief notes, for each report, and are called for at irregular intervals. A brief final examination is given.

Two to four seniors who have taken this course serve in the department library as student assistants. Three of the men found use for the training in library work in their commercial work during the past summer. One who had also worked in the department library has a good position as "reference librarian" with a large company interested in chemical work.

The library lectures alone have been used for reference by graduate students, especially those who have not had access to large libraries, and wish to learn what is available at Illinois.

MARION E. SPARKS
UNIVERSITY OF ILLINOIS

RESEARCH WORK AT THE UNIVERSITY OF MICHIGAN BIOLOGICAL STATION DURING THE SUMMER OF 1917

RESEARCH work was carried on at the biological station of the University of Michigan, by members of the instructional staff and by a number of students. Because of the lack of suitable laboratory space and equipment, the character of work undertaken was limited largely to systematic and ecological work on plants and animals, the behavior of birds, the embryology of certain fishes and life histories of parasitic worms. This is fundamental work, however, and as knowledge of the local fauna and flora is extended it is desired to give opportunity for careful physiological work. While the cold, late season doubtless interfered with certain investigations continued from previous years, it permitted the securing of many plants in blossom which in ordinary seasons have finished their blossoming before the opening of the station, and by retarding the breeding season of many animals an opportunity was given to take at the height of their breeding season several animals not usually found breeding during the session.

Dr. J. H. Ehlers, of the University of Michigan, collected about two thousand specimens of flowering plants comprising about two hundred and fifty species. A number of these represented genera and species not included in the published list of this region.

Mr. Lee Bonar, of the University of Michigan, under direction of Dr. Ehlers, collected plants affected with fungous diseases with the view of listing the host plants and studying the parasitic fungi.

Miss Margaret Pengelly, under Dr. Ehlers's direction, made a collection of the grasses of the region. Fifty species were collected, forty-five of which have been identified. Further collections are planned before publication of results.

Miss Lois Smith, of Colorado College, research assistant in botany, was engaged in the collection and study of sedges of the genus *Carex*. This work had been begun in 1914 when forty-nine species were collected and identified. During the past summer a large number of specimens were collected, among them a number of species not included in the previous list. The material is now being studied by Miss Smith and a published report on the work may be expected soon. The specimens belonging to the above collection will be placed in the herbaria of the station and of the university, while some will be available for exchange.

Dr. Richard M. Holman, of Wabash College, and Mr. Ernest Reed, of the University of Michigan, have made a beginning in the study of the aquatic cryptogamic plants. They devoted the greater part of their time to the identification of the algal forms of the lakes and streams of the region, to the study of the topography and hydrography of these lakes, and to collecting such facts as they were able relative to the spatial and seasonal distribution of the forms. Weekly temperature readings were made at ten foot depth intervals at four stations on Douglas Lake and at Lancaster, Munro and Vincent Lakes. Surface plankton hauls were taken at all these stations weekly, and plankton samples were taken at depth intervals of twenty feet in Douglas Lake. Bottom samples were also taken in order to determine diatom species not found

in the plankton during the summer. Many collections of algæ were made in other lakes, in various streams and bogs. Many determinations have been made and considerable preserved material awaits determination.

In plant ecology, instrumental field work on a new phase of the evaporation-plant-succession problem was carried on by B. H. Grisemer, of Sisseton, S. Dak., and E. E. Watson, of the University of Michigan, under the direction of Dr. F. C. Gates. Field work on a descriptive account of the plant associations and their successional relationships was continued and extended by Dr. F. C. Gates, of Carthage College.

Under the direction of Drs. Gates and Holman, the anatomical structure of the leaves of certain land plants, this year growing submerged, was investigated by Miss Mabel Hardy, of the Highland Park, Michigan, High School; the anatomy of *Scirpus validus* from different associations by Miss Winifred Corcoran, student in the University of Michigan, and the anatomical characteristics exhibited by the leaves of the dominant species of the hardwoods and the aspens by E. L. Lambert, of Carthage College.

Professor Max M. Ellis, of the University of Colorado, has brought the survey of the fishes of the region to a point where the publication of results seems desirable. This work has covered three problems: (*a*) The species of the region; (*b*) the local distribution of these species and (*c*) the relations between the existing fish fauna and that of the Great Lakes. Two papers on this work will be ready for publication shortly. He also studied the eggs and embryology of six species of fishes during the summer. Large series of embryo fishes were obtained for comparative studies. The first of these studies will be completed during the winter. Additional collections of a new species of Branchiobdellid worm (description now in press) were obtained, and some experiments concerning the feeding habits and food of these worms were carried on during the summer. These experiments were supplementary to work in progress at the University of Colorado. A collection of Branchiobdellid worms was made in the Lake Huron and Potagannissing Bay waters. These worms are in hand at present and the report will soon be sent to press.

Professor Ellis and Mr. G. C. Roe, of the University of Colorado, have recently published a paper in *Copeia* on the destruction of log perch eggs by suckers. This paper was based on data collected at the station during the past summer.

Mr. Roe has completed his collections of mosquitoes started last summer and expects to complete his work on these insects soon.

Dr. A. R. Cooper, of the University of Illinois, research assistant in zoology at the station, devoted his attention to the parasites of the fishes of the region with particular emphasis on the life-histories of the members of the cestode order, Pseudophyllidea. He examined one hundred and fifteen hosts belonging to seventeen species but took only three species of Pseudophyllidea. From young gulls, *Larus argentatus,* several cestodes, probably belonging to the genus *Diphyllobothrium* Cobbold, were taken. Many specimens of a cestodarian worm in various stages of development were taken from suckers.

Mr. H. C. Fortner, working under the direction of Dr. La Rue, studied the parasites of frogs from several localities of the region. Some interesting data on the local distribution of frog parasites were secured. So far as determined at present the only new species found was a species of the tapeworm *Ophiotænia,* which constitutes the first record of the taking of tapeworms of this genus from *Anura* of North America. Further collections are needed to complete the work.

Dr. George R. La Rue investigated the parasites of fishes, birds and snakes of the region. In all [illegible] hosts belonging to nineteen species were [illegible]. A number of species not taken during the summer of 1912 were secured. The collections are being studied and it is hoped that they will yield interesting data on the distribution and life histories of certain parasites.

Professor R. M. Strong, of Vanderbilt University, continued his work on problems of

sense physiology and behavior in birds. For this purpose young herring gulls were secured, kept in a suitable cage on the beach and fed on small dead fishes until during the third and fourth weeks, all of the gulls but one died as the result of heavy trematode infestation secured from the fish. The death of these gulls seriously interfered with the work for a large part of the season.

Professor Strong obtained a considerable amount of data concerning the location of many colonies of breeding herring gulls on the Great Lakes. He also studied the distribution and activities of the herring gull from the standpoint of one of the topics recommended by the committee on zoology of the National Research Council.

Miss Edith Priscilla Butler worked with Professor Strong on the reaction of gulls to sound stimuli. Some interesting data to be published later were obtained concerning the hearing of gulls. Observations were made on the docility of gulls and their capacity for learning.

Mr. E. L. Lambert and Miss Dorothy Cashen assisted Professor Strong in making records of the rate of growth of young birds. Mr. Roland Hussey worked with Professor Strong on the activities and distribution of birds in selected areas near the station. He visited these areas frequently and obtained important data correlated with weather and time conditions.

Mr. F. N. Blanchard, of the University of Michigan, collected data on the habitat and habits of the milk snake, and also did systematic work on this form. He made a determination of the Cicindelid fauna of the region, relative abundance of the species, the habitats of the adults and the habits of some of the more abundant species.

George R. La Rue,
Director

SCIENTIFIC EVENTS

THE PROPOSED TRANSFER OF THE UNITED STATES NAVAL OBSERVATORY TO THE SMITHSONIAN INSTITUTION

Secretary Daniels has sent the following letter to Chairman Padgett, of the House Committee on Naval Affairs:

My Dear Mr. Padgett: The Navy Department wishes to express most emphatically its disapproval of H. R. 10954 to change the name of the United States Naval Observatory and to transfer the same to the Smithsonian Institution.

The United States Naval Observatory has grown to its present proportions and position in the astronomical world through the efforts and under the control of the Navy and this department believes that its continued efficiency can best be maintained by retaining the present organization.

Any interference in the work of the observatory at this time when all are engaged in war work in addition to regular routine duties interrupts the supply of nautical instruments to the active fleet which may cause disaster.

The work done to keep up the supply of chronometers, sextants, compasses and other necessary instruments is more or less confidential and it is advisable not to put it in this communication, but it will be furnished in a verbal report if desired.

In addition to its work for the Navy, the observatory has the custody of sextants and chronometers purchased by the Shipping Board.

In March, 1909, the Secretary of the Navy issued an order establishing an astronomical council and stated, "The astronomical work of the Naval Observatory shall be so planned and executed as best to subserve the following purposes and no others, to wit:

"To furnish to the Nautical Almanac Office, as far as may be possible, such observations and such data as may be needed for carrying out the purpose of the law under which the appropriations for that office are made from year to year, which is as follows:

"'For . . . preparing for publication the American Ephemeris and Nautical Almanac and improving the tables of the planets, moon and stars . . .'

"The principal work of the observatory shall be in the field of the astronomy of position as distinguished from astrophysical work, and shall be the continued maintenance of observations for absolute positions of the fundamental stars and of stars which are to be made fundamental, and in addition the independent determination by observations of the sun, of the positions of the stars, moon and planets with reference to the equator and equinoxes.

"Truman H. Newberry,
"*Secretary*"

The duties of the institution have been so arranged that it is believed entirely satisfactory results have been attained, while the operations move with a common purpose known to the entire staff. The council has held its regular meetings and special meetings for the consideration of matters requiring prompt action.

The Naval Observatory consists of an astronomical department for securing the most accurate positions of the heavenly bodies possible; a nautical department in which are tested and repaired navigational instruments for the Navy; an office for the preparation of a nautical almanac by which the ships ascertain their positions at sea; a time service by which the operation of all railroads, ships and commercial bodies are furnished accurate time daily; a compass office in which the latest form of compasses are examined, as well as a means to show the younger naval officers the latest improvements in them; an inspection department, with inspectors at New York, Boston and San Francisco, under direct supervision of the observatory. These inspectors are on duty at the factories of manufacturers engaged in the production of navigational material for the Navy and United States Shipping Board. There is not another national observatory in any country that has all these departments combined under one head and carried on in one plant. Therefore, when this question of expense arises and comparisons are made, those separate departments should be combined to get the true cost.

A few of the complimentary notices from competent authorities are appended.

GIFT TO THE RED CROSS FOR MEDICAL RESEARCH IN FRANCE

The Atlantic Division of the American Red Cross has announced that hereafter all expenditures for vivisection would come from a fund which had been contributed by an individual. The announcement, which came here from Harvey D. Gibson, general manager of the Red Cross in Washington, said that this fund also would be used to reimburse the treasury of the organization for money already spent in experiments on living animals. Mr. Gibson's statement in part was as follows:

Considerable public and private criticism has been made of an appropriation of the American Red Cross in August, 1917, for medical research work in France, because partly involved in this work was experimentation upon living animals for the purpose of finding methods of prevention and remedies for new and strange diseases among soldiers. This appropriation was made at a time of emergency, upon the recommendation of army medical officers and of a number of eminent scientists in this country. Prompt action was necessary, and it seemed to officers of the Red Cross at the time that the use of money in this way was proper from the Red Cross point of view, for it would be difficult to imagine any more imperative duty upon the Red Cross than to seek for every means of prevention and remedy for sickness among soldiers.

The Red Cross did not, as has been stated, appropriate this money for abstract medical research and experimentation. It was to be used for the direct and immediate purpose of finding ways to prevent or cure wounds and sickness among American soldiers. It was strictly a war measure. It develops, however, that there are large numbers of earnest Red Cross members who have sincere convictions against the use of animals for discovery of remedies for sickness. We recognize that it should be an obligation of the Red Cross management to show deference to such honest conviction.

Realizing the situation, an individual has come forward and has offered to supply money necessary for this work so that none shall be taken from the general funds of the Red Cross. The fund provided will also be used to reimburse the Red Cross General Fund for any expenditures in connection therewith in the past. The War Council decided to accept this offer without in any way taking a position either for or against the question in controversy, but because they do not wish their acts to be considered to be in conflict with the sincere convictions of Red Cross members.

The New York *Times* says in an editorial article:

It will be with regret deeply tinged with indignation that all sane and reasonably enlightened people will hear of the decision by the heads of the Red Cross not to use for animal experimentation—often and almost always incorrectly called "vivisection"—the money hitherto appropriated by them for that purpose. The decision may mean avoiding the loss of a few contributions to the Red Cross funds, but it also means the triumph of vicious ignorance over common sense, and it will encourage to further efforts the members of the most detestable and not the least dangerous group of men and women to be found in the United States.

The campaign of the anti-vivisectionists is waged, now as always, with no other weapons than those of calumny and falsehood. They deliberately and persistently make the most abominable accusations against men who have done and are doing an enormous amount of successful work to mitigate human suffering and to save human life. Incidentally, these same workers are conferring like advantages on innumerable domestic animals, but let that pass. The immediate issue is that interference with animal experimentation just now decreases the safety of the men in our army and navy, makes impossible, so far as the interference is effective, the conquest of several terrible diseases to which the fighters for liberty are still exposed, and sets up the absurd claims of fanatic dgenerates against the well-demonstrated truths of medical science.

And the Red Cross cautiously says that it does not take sides for or against "vivisection"! Such caution is reprehensible—is utterly unworthy of that great and beneficent organization. It should take sides, standing for right and against wrong. The immediate profit of doing anything else or less will be dearly bought in future loss of both money and respect. Red Cross money, in the amount that was proposed, could not possibly have been better invested than in the establishment of a biological laboratory near the scene of war for the study of the maladies of soldiers which this sort of research has not yet conquered. It was weak, and worse than weak, for the Red Cross to heed the hysterical shrieks and the monstrous charges of venality and murder that came from a few people whom it strains charity to call deluded or insane.

THE JOINT INFORMATION BOARD ON MINERALS AND DERIVATIVES

For the purpose of systematizing the handling of official inquiries regarding minerals and mineral products the Joint Information Board on Minerals and Derivatives has been formed. This body, which will serve as a clearing house to secure the prompt preparation and transmittal of data from a single authoritative source without duplication effort, is composed of representatives from the various government bureaus, boards and departments interested.

The war has caused an increased demand by various officials for all available information regarding raw materials essential to the government, and this demand has caused a notable increase in the work and the personnel of those bureaus that had in the past been directly concerned in mineral investigations.

This joint board was created to coordinate the activities of all concerned. Its purpose in no wise curtails but supplements the existing activities; its function is to make the equipment and personnel of the various bodies concerned better known and more readily available to the other organizations and to bring about an even more effective operation.

Mr. Pope Yeatman, of the War Industries Board, Division of Raw Materials, is chairman of the Joint Information Board, and all inquiries should be addressed to Edson S. Bastin, Secretary Joint Information Board on Minerals and Derivatives, Room 5037, New Interior Building, Washington, D. C.

Following are the government departments and official organizations and names of representatives on the board:

War Department.—Bureau of Ordnance, Lieutenant Colonel R. P. Lamont, Sixth and B Streets NW.

Navy Department.—Bureau of Ordnance, Commander R. S. Holmes, Lieutenant Commander N. W. Pickering, New Interior Department Building.

War Industries Board.—Division of Raw Materials, L. L. Summers, Pope Yeatman (chairman Joint Information Board), Council of National Defense Building. Division of Statistics, F. G. Tryon, H. R. Aldrich; Commercial Economy Board, M. T. Copeland; Council of National Defense Building. Bureau of Investigations and Research, F. H. Macpherson, Council of National Defense Building.

Department of Agriculture.—Bureau of Plant Industry, K. F. Kellerman; Bureau of Soils, Frederick W. Brown; Bureau of Animal Industry, R. M. Chapin; Bureau of Chemistry, W. W. Skinner; Federal Insecticide and Fungicide Board, John K. Haywood.

Department of Commerce.—Bureau of Foreign and Domestic Commerce, C. D. Snow, assistant chief; Bureau of Standards, Henry D. Hubbard.

Treasury Department.—Bureau of the Mint, Frederick P. Dewey; Division of Customs, George W. Ashworth; Office of Internal Revenue, A. B. Adams.

Interior Department.—Geological Survey, Adson S. Bastin (secretary of Joint Information Board); Frank J. Katz, New Interior Department Build-

ing; Bureau of Mines, Harvey S. Mudd, New Interior Department Building.

U. S. Food Administration.—Division of Chemicals, Charles W. Merrill.

U. S. Fuel Administration.—Oil Division, Thomas Cox; Coal Division, C. E. Lesher, New Interior Department Building.

U. S. Shipping Board.—C. K. Leith, J. E. Spurr, New Interior Department Building.

War Trade Board.—Bureau of Research, S. H. Salomon, 1027 Vermont Avenue; Bureau of Imports, Lincoln Hutchinson, Bond Building; Bureau of Exports, S. C. Thompson, 1435 K Street NW.

U. S. Tariff Commission.—Guy C. Riddell, 1322 New York Avenue NW.

Department of State.—Consular Service, H. A. Havens.

U. S. National Museum.—Division of Mineral Technology, Chester G. Gilbert.

Federal Trade Commission.—C. C. Houghton, 921 Fifteenth Street NW.

National Research Council.—John Johnston, 1023 Sixteenth Street NW.; Section of Metallurgy, H. M. Howe, 1023 Sixteenth Street NW.; Division of Geology and Geography, John C. Merriam, 1023 Sixteenth Street NW.

Director General of Railroads.—Car Service Section, G. F. Richardson, Interstate Commerce Building.

PHYSICIANS FOR THE ARMY AND NAVY SERVICE

Dr. Franklin Martin, chairman of the committee on medicine of the advisory commission of the Council of National Defense, appeals for an increased enrollment of doctors for service as medical officers in the Army and Navy.

Surgeon-General Gorgas asks for 5,000 medical men for the Army with which to establish a reserve as fast as the 16,000 medical officers now in training and in uniform are ordered to France. While men between the ages of 25 and 45 are most desirable, the maximum age limit for medical officers is 55 years. Physicians are commissioned as first lieutenants, captains and majors. After acceptance of their commissions they are given a reasonable length of time in which to arrange their affairs before assignment to active duty.

An increased demand for naval medical officers has been created by the additional responsibility of the Navy in protecting ships engaged in the transportation of troops and supplies to Europe. The following letter from Surgeon-General Braisted is self-explanatory:

Washington, D. C., April 5, 1918.

Dr. Franklin Martin,
Council of National Defense.

My Dear Doctor: May I request the cooperation of the Council of National Defense in conveying to the medical profession the fact that the Medical Department of the Navy is urgently in need of additional medical officers? Anything that you can do to assist us in filling these needs will be greatly appreciated.

Thanking you in advance for this, as well as for your many acts of cooperation in the past, I am,

Very sincerely, yours,
W. C. Braisted,
Surgeon General, U. S. Navy

Two thousand medical officers are required to meet the demands for immediate expansion and to establish a reserve.

Application blanks may be obtained from the Surgeon General of the Army, the Surgeon General of the Navy, the Council of National Defense, or examining boards for medical officers located in all the large cities of the country.

SCIENTIFIC NOTES AND NEWS

Mr. Samuel Henshaw has been appointed director of the Harvard University Museum.

Dr. John Johnston, of the Geophysical Laboratory of the Carnegie Institution, has been appointed secretary of the National Research Council.

Dr. Stephen Smith has resigned as member of the New York State Board of Charities, an office which he has held for many years. Dr. Smith was ninety-five years of age on February 19.

Professor Russell H. Chittenden, director of the Scientific School of Yale University, Professor Graham Lusk, of the Cornell Medical School and Mr. John L. Simpson, of the United States Food Administration, have been representing the United States at the inter-allied food conference in Paris. The immediate purpose of the conference is to establish

a scientific rationing system whereby the individual will be enabled to make the greatest effort on the minimum amount of food.

LEAVE of absence for the remainder of the year has been granted by Harvard University to Louis C. Graton, professor of economic geology, to enable him to take charge of the work of the Copper Producers Committee in Washington.

MR. H. E. IVES, of the United Gas Improvement Company of Philadelphia, Pa., has entered the Science and Research Division of the Signal Corps.

DR. FREDERIC BONNET, JR., professor of chemistry at the Worcester Polytechnic Institute, has resigned to accept the position of chief chemist at the new Perryville plant of the Atlas Powder Company.

PROFESSOR ADOLPH F. MEYER, associate professor of hydraulic engineering of the University of Minnesota, has accepted a position as engineer for the Minnesota-Ontario Power company and will resign his position on the faculty probably at the end of the current year.

DR. W. F. FARAGHER has resigned his position as research chemist for the Alden Speare's Sons Co. to become senior fellow at the Mellon Institute in Pittsburgh. He will work on crude petroleum.

MISS KATHERINE MARDEN, assistant bacteriologist in the Massachusetts State Department of Health, has been appointed sanitary bacteriologist in the United States Public Health Service, and has been ordered to proceed to Greenville, S. C.

DR. ABRAHAM JABLONS, of the Bureau of Preventable Diseases, Department of Health, City of New York, is on active duty in the United States Naval Reserve Force, at the Naval Hospital, Brooklyn, New York.

THE Rockefeller Institute recently tendered a banquet to Dr. G. Gasteñeta, subdean of the medical department of the University of Lima, Peru, who has been on a brief visit to the United States.

THE Gill Memorial of the Royal Geographical Society has been awarded to Dr. Cuthbert Christy for his surveys and explorations in Central Africa.

THE *Journal of the American Medical Association* states that the seventieth birthday of the well-known authority on physiologic chemistry and histology, Professor C. A. Pekelharing, of the University of Utrecht, falls on July 18, and his friends and pupils are collecting a fund to erect a tablet in his honor or endow the laboratory for physiological chemistry there. The secretary of the committee in charge of the testimonial is Dr. C. J. van Hoogenhuyze, Banstraat 8, Amsterdam.

THE officers of the Royal Microscopical Society, elected for the ensuing year, are: *President*, J. E. Barnhard; *Vice-Presidents*, E. Heron-Allen, F. Martin Duncan, A. Earland and R. Paulson; *Secretaries*, Dr. J. W. H. Eyre and D. J. Scourfield.

THE Medical Research Committee of Great Britain has appointed a special committee to consider the methods of manufacture, biological testing, and clinical administration of salvarsan and its substitutes used in Great Britain, and the results of these, and to propose to the Medical Research Committee specific investigations aimed at improving those methods and results. The committee consists of Dr. H. D. Rolleston, C.B., temporary Surgeon-General R.N. (chairman), Professor F. W. Andrewes, M.D., F.R.S., Professor Wm. Bulloch, M.D., F.R.S., Dr. H. H. Dale, F.R.S., Lieut.-Colonel L. W. Harrison, D.S.O., R.A.-M.C., and Dr. F. J. H. Coutts, assistant medical officer, Local Government Board (secretary).

PROFESSOR FREDERICK B. LOOMIS, of Amherst College, recently addressed the Middletown Scientific Association at Wesleyan University on "The Patagonian Pampas." The subject matter of this lecture was taken from facts gathered during five months' traveling over the Pampas, while hunting for extinct animals.

THE Cutter lectures on preventive medicine and hygiene will be delivered at the Harvard

Medical School from 5 to 6 P.M. on April 25 and 26, by Frederic S. Lee, A.M., Ph.D., professor of physiology of the College of Physicians and Surgeons, Columbia University, on "Industrial Efficiency and the War."

Dr. W. Eagle Clarke, keeper of the Natural History Department of the Royal Scottish Museum, Edinburgh, has been elected president of the British Ornithologists' Union, in succession to Col. Wardlaw Ramsey.

In view of a biography of the late Perciva1 Lowell, it is requested that any one possessing letters of his will be kind enough to lend them to G. R. Agassiz, 14 Ashburton Place, Boston, Mass. All letters lent will be promptly copied and returned.

Professor Ewald Hering, the eminent physiologist, professor at Leipzig, has died at the age of eighty-four years.

There is announced in *Nature* the death of Miss B. Lindsay, on December 16 last, at Onchan, Isle of Man. She was known for her experimental work in the morphology of birds and molluscs and for her text-books.

Professor G. Meslin, director of the physical institute laboratory of the University of Montpellier, known for his work on optics, died on January 11, aged fifty-six years.

There is need for about 100 women bacteriologists to take the place of men in the cantonment laboratories, the Surgeon General's Office of the United States Army announces. The service of the men is demanded for the hospital units which are going abroad and their places at the home cantonments are to be filled by women. Applications are arriving from all camps, some asking for as many as nine women. A good practical knowledge of clinical pathology and diagnostic bacteriology is required for the work. The present salary is $720 with maintenance and $1,200 without, with transportation furnished by the government. Applications may be made to Office of the Surgeon General, Washington, D. C.

The United States Civil Service Commission announces an examination for apprentice draftsman, for males only, to fill vacancies in the Coast and Geodetic Survey. The entrance salary will be at the rate of $60 a month during the time of probationary service of six months, with subsistence at the rate of $1 a day when serving on shipboard or in camp, and $2 a day when living on shore and boarding. Those serving a satisfactory probationary period of six months will be appointed draftsmen at $900 a year and will be eligible for appointment to one of the statutory positions in the drafting section of the Coast and Geodetic Survey at Washington, D. C., after passing the examination for topographic draftsman. On entering the service, apprentice draftsman will be given special instruction in the office at Washington, D. C., for two or more months, and then will be ordered for duty with a field party. In the field they will be given elementary instruction in the several branches of surveying and afforded an opportunity of becoming familiar with survey methods by taking part in the different classes of field work. At the close of the field season they will be ordered to the office at Washington, D. C., where they will be engaged in completing the records of the past season's work and at the same time they will be given special instructions to fit them for more advanced cartographic work.

The next annual session of the Biological Laboratory at Cold Spring Harbor, Long Island, New York, will be held during June to September. Class work will begin Wednesday, July third and continue for six weeks. Courses of instruction are offered in field zoology by Drs. Walter and Kornhauser, bird study by Mrs. Walter, comparative anatomy by Professor Pratt, sanitary entomology by Mrs. Elizabeth H. Wright and others, animal bionomics and evolution by Dr. Davenport, systematic and field botany by Dr. John W. Harshberger, a training course for field workers in eugenics by Drs. Davenport and Laughlin. Advanced work in zoology and botany is offered by the staff. Professor and Mrs. H. H. Wilder also offer a course of lectures and laboratory work on physical anthropology. This last course and the course on sanitary entomology and the elementary course in botany are this

year adapted to war conditions. Announcement and further information can be obtained by addressing C. B. Davenport, Cold Spring Harbor, New York.

The meeting of the British Association, which it was hoped would be held in Cardiff this year, has been cancelled. The local committee has reluctantly decided that satisfactory arrangements could not be made to ensure success for the meeting, and has sent a resolution to that effect to the council of the association. The council has accepted this view, so that for two years in succession the annual assembly of workers in all departments of science will not take place. Sir Arthur Evans has consented to occupy the office of president for another year, and there will be a statutory meeting in London on July 5 to receive reports of committees and transact other business, but otherwise the corporate life of the association will continue in a state of suspended animation, though there never has been a more favorable time than now to make the nation realize the debt it owes to science for the successful conduct of the war and the need for unceasing scientific activity to prepare for the industrial struggle which the future must bring.

UNIVERSITY AND EDUCATIONAL NEWS

Sir William Schlich, F.R.S., professor of forestry in Oxford University, has received £500 from a donor who wishes to remain anonymous, to be added to the fund for the permanent endowment of the professorship of forestry. With the sums already contributed, the capital of the fund now amounts to over £6,300, and the annual income from all sources to about £300 a year, making about half of what is required.

A committee, of which Sir William Osler is chairman, met in Cardiff recently to prepare a scheme for the Mansel-Talbot chair of preventive medicine in the University of Wales endowed by Miss Talbot. When the scheme had been approved the election of a professor will be proceeded with.

President Benjamin Ide Wheeler, of the University of California, has again asked for an increase in salaries for members of the California faculty. A year ago men of the grade of instructor and assistant professor received an increase of ten per cent.

Julian L. Coolidge, assistant professor of mathematics at Harvard University, has been advanced to a full professorship.

At the Pennsylvania State College, E. H. Dusham has been promoted to be professor of entomology; M. D. Leonard, instructor in entomology at Cornell University, has been appointed instructor in entomology extension and R. C. Walton, of the Ohio Experiment Station, instructor in plant pathology.

Dr. Kirtley F. Mather, professor of paleontology at Queen's University, Kingston, Canada, is acting professor of geology and geography at Denison University, Granville, Ohio, for the spring term.

DISCUSSION AND CORRESPONDENCE

THE EXISTENCE OF LECITHIN

Some eight years ago and again very recently, Barbieri[1] has reported results of experiments which he claims proves the non-existence of lecithin. His arguments are the following:

> The fatty matter of egg yolk can be separated in a state of purity by the aid of neutral solvents. The nitrogen-containing bodies can be removed by simple dialysis or by repeated washing with distilled water in the presence of a little alcohol. The fat yields on hydrolysis nothing but glycerol and fatty acids. Glycerolphosphoric acid can not be obtained by treating the egg yolk with a neutral solvent. It appears only after hydrolysis. The phosphorus occurs only in the form of metallic (potassium, sodium, calcium or magnesium) salts of phosphoric acid and is entirely dialyzable. Egg yolk contains no trace of choline, the supposed biological choline being a product of either the degradation of the ovochromin or of putrefaction.

From these results it would appear that the compound ordinarily called lecithin is a mixture of fats, phosphates and dialyzable nitro-

[1] Barbieri, N. A., *Comp. rend.*, 1910, 151, 405; *Gaz.*, 1917, 47, 1–13; *J. Chem. Soc.*, 112, I., 238.

genous substances. Such a mixture should be capable of some separation by ordinary chemical means. Any method of rigorous purification, such as that employed in the purification of lipoids, would certainly effect some change in the composition of this mixture.

Without criticizing the arguments of Barbieri, some of which (*e. g.*, the statement that glycerolphosphoric acid may be formed during the process of hydrolysis, from the glycerol of the fat and dilute phosphoric acid) certainly are open to criticism, we offer the following argument for the existence of lecithin.

The work of earlier workers seems to be sufficient to show that lecithin is a chemical substance, even though the analyses of the products from various sources (brains, heart, liver, egg) did not agree very well. But if any doubt existed as regards the existence of lecithin, it would seem that the recent work of Levene and West[2] proves that such an idea is not tenable. Not only has lecithin, as such, been isolated from the above-mentioned sources, but derivatives have been prepared and subjected to rigorous purification, always with the same result. The following facts may be mentioned.

Lecithin, from various sources, such as the primary alcoholic extract, the primary ethereal extract, the secondary alcoholic extract, or the fraction dissolved in egg oil, has been precipitated as the cadmium chloride salt, giving a product of very similar composition. This salt has been purified by crystallization from two parts ethyl acetate and one part 80 per cent. ethyl alcohol, or by extraction with ether and subsequent crystallization, with little or no change in its composition. Furthermore, the salt may be decomposed with ammonium carbonate (Bergell) and the free lecithin again converted into its cadmium chloride salt; this salt will still have the same elementary composition.

A more convincing proof of the chemical individuality of lecithin is found in the preparation of hydro-lecithin. Lecithin (especially those samples which have been washed with water and acetone, according to the directions of MacLean) is very readily reduced with hydrogen (using Paal's method, with colloidal palladium as the catalyzer) and yields a crystalline tetrahydrolecithin, which may be obtained in an analytically pure form by crystallization from methyl ethyl ketone, and once pure, may be recrystallized repeatedly, without change in composition, from such solvents as methyl ethyl ketone, alcohol, or ethyl acetate. If, as Barbieri claims, fats are present, they would remain in the methyl ethyl ketone liquors; our experience in the purification of cerebrosides indicates that this is one of the best solvents for the removal of fat.

[2] Levene, P. A., and West, C. J., *J. Biol. Chem.*, 1918, 33, 111; 34 (in press).

We have also combined these two processes. Lecithin has been precipitated from alcoholic solution by cadmium chloride, the salt decomposed with ammonium carbonate, the free lecithin washed with water and acetone, and then reduced with hydrogen. In this way Levene and West have obtained a chemically pure tetrahydrolecithin.

It is hard to believe that a mixture of choline, glycerides, and phosphates, such as Barbieri claims for lecithin, can be subjected to the above methods of treatment and give, in every instance, a body with identical chemical composition. Rather, I believe, it is easier to accept the chemical individuality of lecithin.

Clarence J. West

Washington, D. C.

DESMOGNATHUS FUSCUS [SIC]

Full many a biologist, in his use of the classics, has encountered two special stumbling-blocks; the fourth Latin declension, and the Greek noun whose gender does not fit its form.

Concerning the first of these, so many anatomical nouns, among them certain of the most commonly used ones, belong to this weak form of declension that the student of anatomy may almost consider the fourth the commonest one for masculines in *-us*. He meets with *ductus*, *arcus*, *fetus*, *plexus*, and *nexus;* with *processus*, *recessus*, *meatus*, *tractus*, and *sinus*, while the five senses, with *sensus* itself, are

all of the fourth declension; *visus, auditus, gustus, olfactus,* and *tactus.* Awkward as is any plural form of these words in English, the anatomist has to come to it, and speak of "arcuses, ductuses, and fetuses," or else appear to talk bad Latin, and repeat the singular form.

The mistaking of an unusual gender, such as a Greek masculine of the first declension, or a Greek feminine of the second, is still easier, as here the erroneous form sounds to us right, and the correct form incorrect. It takes a bold man indeed to speak of *Erigeron bellidifolius* or *Plethodon glutinosus,* where the masculine form used for the genus looks like a neuter, and it seems to us still more unnatural to say *Desmognathus fusca,* instead of the (to us) more natural *fuscus.* Unfortunately this mistake was made at the original naming of this species by Spencer F. Baird in January, 1850, and this initial mistake was followed by several illustrious men, both anatomists and systematists, among others by Wiedersheim (1887), W. K. Parker (1879), Boulenger (1882), and as late as 1909, by Gadow. On the other hand the correct form *fusca* was used by Cope (1889), by the later systematists, G. M. Allen, Fowler and Dunn, and in the anatomical and embryological writings of Kingsbury, Hilton, Mrs. Seelye, Mrs. Wilder, H. H. Wilder and others. Moore, in describing his new Salamander, *Leurognathus marmorata,* used the correct feminine form for the specific name, as did also Dunn in his new sub-species of *Desmognathus, ochrophaea carolinesis.* Since now, practically all the writings of the last decade have corrected the old errors, and restored *Desmognathus* to its proper gender, it is a great pity that in the new (1917) check list of Reptiles and Amphibians by Stejneger and Barbour, the old erroneous masculine form is brought back again, and we find *Desmognathus fuscus* in all its shame. And, in addition to this, come all the other *Desmognathoe; ochrophaea, quadrimaculata* (or, following the original error, *quadramaculata*), and the sub-species *auriculata,* all changed, to the masculine like the maiden Coenis of the poet Ovid, appearing in the form of nondescript gynandromorphs! Let us hope that, unlike this changeable person, the species thus transmuted will not become invulnerable.

But, having once, in flat defiance of Homer, Herodotus, and every other Greek writer from Hesiod to Eleutherios Venizelos, changed the grammatical gender of the noun γνάθος it becomes necessary to change also the specific name of Moore's *Leurognathus,* which, instead of appearing as Moore originally gave it (1899), as *Leurognathus marmorata,* is also masculinized as *Leurognathus marmoratus.*

Still more unfortunate are the mistakes in quoting both Moore and Dunn, the former being quoted as having originally used the form in *-us,* which he did not, and the latter, as having written *ochrophaeus carolinesis,* whereas he was most careful to use the feminine in *-a.* Altogether it is a bad mix-up, and being in a check-list, which will be used as an authority for years to come, it may actually foist this glaring solecism upon American herpetologists beyond the power of correction.

Mark Twain, in his rules for improving the German language, suggests the reconstruction of their genders in accordance with the plan of the Creator, "as a tribute of respect if nothing else." In the correction of "*Desmognathus fuscus*" we have a chance to show some respect to the Greek language.

Harris Hawthorne Wilder

A MOLLUSCAN GARDEN PEST

In a previous number of Science[1] the writer called attention to the presence of a slug (*Agriolimax agrestis* Linn.) in gardens which was doing considerable damage to such vegetables as cauliflower, lettuce and potatoes. During the past summer (1917) and early fall this slug has become much more troublesome and in some localities has caused considerable damage.

At Brewerton, N. Y., it was observed eating cabbages and potatoes; in Syracuse it has attacked potatoes, causing a large amount of injury in several fields and gardens. The writer

[1] Science, N. S., Vol. XLIII., p. 136, 1916.

has taken occasion to question several persons who had made gardens in vacant lots and in fields near the city and in all cases the slug was reported to have been present in numbers sufficient to cause appreciable damage. In one garden the slugs had eaten into the tubers to such an extent as to destroy two thirds of the potato. Several slugs were found in a single potato and associated with them were many wire worms (probably larvæ of the beetle *Agriotes mancus* Say) and sowbugs (isopods). The wire worms have been reported as very abundant in potatoes, both in Syracuse and in Rochester, N. Y. Damage from the slug has been reported from Rochester, Canandaigua and Geneva.

It is evident that this slug is becoming a troublesome pest in garden truck farms and small gardens and a problem arises as to the best means of combating its ravages. It can be controlled when its depredations are confined to the surface plants by spreading fine ashes about the plants, which cause the animal to exhaust itself by the copious flow of mucus, induced by the irritant action of the ashes. But this will not affect those individuals that enter the ground and attack the tuber below the surface. It has been suggested that if the grass surrounding the garden patch be kept short it will prevent the slugs from hiding near the garden during the day, the active time of the species being at night. The placing of boards about the garden will also act as a trap, the slugs retiring beneath these boards during the day when they may be collected and killed.

This slug is one of the commonest snails in western New York. In many parts of Syracuse it is abundant after rains, crawling over the sidewalks, leaving behind it a slimy, glistening trail. Its tendency to adopt the products of the garden for food in place of its natural food indicates that it must be classed among the agencies injurious to farm and garden products.

It may be of interest to note that a related species of slug (*Agriolimax campestris* Binney) has been observed[3] to eat plant lice (*Phorodon mahaleb* Fousc.) in considerable quantity. Under these circumstances it would be placed among beneficial animals. Observations on the natural food of these small slugs would be of interest and value.

[3] F. M. Webster, Bull. 68, Ohio Agric. Exp. Station, pp. 53–54, 1896.

Frank Collins Baker
New York State College of Forestry,
Syracuse University

THE YELLOW CLOTHES MOTH

Since my note on the yellow clothes moth was published, I have learned with regret that I overlooked a record of original observations on this species by Professor Glenn W. Herrick, published in 1915, in his "Insects Injurious to the Household." It is a matter of interest that the two accounts agree almost exactly with respect to the details treated in common.

Professor Herrick had already noted the common distribution of *Tineola* as compared with *Tinea*, the number of eggs laid (one individual), the appearance of the egg, the hatching period, the approximate pupal period, and the fact that the first brood for each year must be mainly derived from eggs of the preceding year.

In regard to the latter point, it may be added that, while as already noted, moths may emerge in every month of the year, there are two periods of much greater abundance. The first begins about the end of April in New York City and lasts through June. With the estimated minimum growth stage of ten weeks, it is unlikely that any of this first brood represent eggs of the same year. During the summer, the flying stage was common enough but nothing like that of the preceding months. In late August again and through September there was another period of abundance, the result undoubtedly of the development of the eggs of the first large brood of moths. Figuring from the whole season it would appear a safe conclusion that the average period of active larval growth is about three months. The actual growth periods, including the winter season, are approximately three and one half months (June–September 15), and eight and one half months (Sept. 15–June).

R. C. Benedict

THE AURORA OF MARCH 7

TO THE EDITOR OF SCIENCE: as a matter of record it may be worth while, even at this late date, to note that the aurora of March 7 was seen in Winter Park, Florida (latitude about 28° 37′). It was visible for a short time only, between 9:30 and 10:00, Central Standard time. Those who saw it described the sky as brilliantly red for perhaps forty degrees along the northern horizon, with streamers extending half way to the zenith.

FRANK P. WHITMAN

WINTER PARK, FLA.,
April 5, 1918

SCIENTIFIC BOOKS

Principes de Géométrie Analytique. Par GASTON DARBOUX. Gauthier-Villars et Cie 1917. Pp. vi + 517.

This important work has elements of interest extending beyond the circle of the professional mathematicians. It was the last mathematical contribution of one of the most noted French scientists and constituted the subject matter of his last course of lectures at the Sorbonne, closing a very successful teaching career which extended over a period of more than fifty years.

The principles of analytic geometry treated in this work relate mainly to the imaginary and the infinite in algebraic geometry, and hence they are also of great philosophic interest. In his Introduction the author states that these principles are too much neglected at the present time, being usually treated in the elementary courses where they can not be developed with the completeness which they merit and which he is free to give them here.

In our American text-books these principles are commonly omitted altogether. Comparatively few students become familiar with such interesting properties as those exhibited, for instance, by the two lines whose equation in rectangular coordinates is $x^2 + y^2 = 0$. Each of these two lines is perpendicular to itself and has the property that the distance between any two of its points corresponding to finite coordinates is zero.

Our students of analytic geometry meet such equations as $x^2 + y^2 + 1 = 0$, which are not satisfied by the coordinates of any real point. They are usually told that these equations represent imaginary curves, but if they consult some more advanced works; *e. g.*, the *Encyclopédie des Sciences Mathématiques* tome III., volume 3, page 260, they find that what they commonly called imaginary circles and imaginary ellipses in their courses in analytic geometry are here called *real* curves. A *real* curve being one whose equation has real coefficients and hence does not need to contain any real point according to these authorities.

These remarks may serve to exhibit the facts that the imaginary in analytic geometry presents views which are quite different from those obtained by the student who confines himself to the consideration of real points, and that authorities do not agree as regards the definition of a real curve when the degree of the curve exceeds unity. Moreover, it is only necessary to recall the two circular points at infinity, which lie on all the circles of the plane, in order to remind ourselves of the fact that infinity also presents matters of interest which escape those who deal only with the finite region.

The volume under review is divided into five books with the following headings: anharmonic ratio, metric definitions, the theorems of Poncelet, Cayleyan geometry, and inversion. It has much in common with a work published by the same author under the title: "*Sur une classe remarquable de courbes et de surfaces,*" 1872, but it contains many later developments. In particular, the part on Cayleyan geometry was developed by the author, according to the preface, during the years 1895 and 1896.

The book is not intended for the beginner in analytic geometry but presupposes some knowledge of this subject. Its chief aim seems to be to lay a solid foundation for the study of the imaginary and the infinite in geometry, and to present the subject in an attractive and simple manner with a view

to securing a wider interest in this extensive field. No other man could have brought a wider knowledge or a more skillful hand to this noble task and the accomplished work is a credit to its author and to his country.

G. A. Miller

University of Illinois

Additional Studies in the Pleistocene at Vero, Florida. Pages 17–82, 141–143, from the Ninth Annual Report of the Florida State Geological Survey, 1917.

The pamphlet, just arrived, comprises five articles of particular interest to anthropologists: one by Professor E. W. Berry, of Johns Hopkins University, on Fossil Plants; one by Dr. R. W. Schufeldt on Fossil Birds; one by Dr. O. P. Hay, of the Carnegie Institution, on Fossil Vertebrates; and a final paper (with a supplement) by Dr. E. H. Sellards, state geologist of Florida, summing up the evidence and the discussion to date with reference to the antiquity of the associated human remains. The three special papers, it should be noted, are concerned mainly with data from stratum No. 3, *i. e.*, the top formation in and at the base of which most of the human remains occur. Of the organic forms found here those either totally or locally extinct are given approximately as follows: mollusks 0 per cent., turtles 50 per cent., birds 33 per cent., mammals 40 per cent., and plants 20 per cent. Dr. Sellards deems this record consistent and after affirming that the exposed Vero section shows "distinct uninterrupted lines of stratification beneath which human materials are found," pens his conclusions in these words: "The human remains and artifacts are contemporaneous with extinct species of mammals, birds, reptiles, and at least one extinct species of plants, as well as with other animal and plant species that do not at the present time extend their range into Florida. The age of the deposits containing these fossils according to the accepted interpretation of faunas and floras is Pleistocene."

The full significance of these remarks is of more than ordinary importance. With the findings of specialists in the fields of geology and paleo-biology no anthropologist will be disposed readily to take issue; and the writer in particular, having spent only a few hours at Vero, is in no position to challenge directly any of the alleged facts; but he ventures, nevertheless, to offer some remarks having general bearing on the situation as now developed.

In the first place, anthropological literature records a score or more of isolated archeological discoveries (Dr. Hay cites some of them) which, because of attending circumstances, have by some been adjudged proofs of extraordinary human antiquity and which thus lend substantial support to the appearances at Vero. Many of these discoveries, like the one before us, are of the *bona fide* sort, requiring no affidavits, and they range from the Tertiary gravels of California to the glacial deposits of New Jersey. Nevertheless, whatever the merits of these data, they have not been generally accepted because their acceptance, in view partly of the known conditions of paleolithic Europe, involved tremendous difficulties in the way of assumptions rather than doing away with them. At the same time it can not be doubted that these very finds have directly inspired many students to the investigation of artificially stratified deposits, both in caverns and elsewhere with a view, if possible, to obtaining supporting evidence that would ultimately result in the credibility of these isolated and questionable discoveries. Now, up to the present time, although this indirect effort has been continued for more than a generation and has ranged geographically from Alaska to Patagonia, nothing satisfactory has come of it. Within the United States alone, both cave and mound deposits have repeatedly been shown to record a considerable range in cultural development, but the associated faunal remains of even the oldest strata have never yielded any but modern species; and this, so far as the published data goes, is true also for the shell mounds of Florida. Under those circumstances no archeologist can be expected to relinquish at once his scepticism concerning the Vero discovery.

In the second place, anthropological investigations go to show that of the fundamental primitive arts, pottery-making, for various obvious reasons, is of relatively late date in culture history, throughout the world. The archeology of the eastern United States seems particularly clear on this point. Thus, it has been demonstrated over and over again that the lower strata of artificial deposits from the Ozark uplift to the Atlantic coast and from lower New York state to Florida are devoid of ceramics. Narrowing the field to the east coast of Florida, we have on record several independent determinations (one by the writer only last spring and not yet published) to the effect that the shellmound people did not at first possess any pottery at all, that after a time they began making a plain dull-reddish earthenware, and that finally, some time before the arrival of European explorers, they took to ornamenting this ware by impressing upon it some simple geometric patterns.

Now pottery fragments, apparently of the undecorated variety, occur also in the Vero deposit, and the archeologist, rather than accepting an extraordinary hiatus in his own data, will be disposed to consider the section in which it was found to be synchronous with the middle period of the local shellmound occupation. To accept the Vero date at its present face value would compel him not only to relegate the development of pottery to an unheard of date but also it would oblige him to assume that this early culture of Pleistocene times was snuffed out and that after some milleniums marked by the arrival of the modern fauna a new and lower type of culture became established which only after a very considerable period reached the level of the original culture. Such a happening is conceivable, but it is not plausible.

So far as the writer can see, the archeologists can do very little more than they have done already toward the solution of the Vero problem. Extended investigation by an archeologist would in all probability yield nothing, because on the real points at issue he would always have to defer to the geologist and the paleontologist. If we could persuade the paleontologist to satisfy himself about the fauna of the shellheaps something might result. Errors of identification may have been made in the past. If he can close the gap between the shellmound fauna and that of the Vero section nobody will be happier than the passing generation of archeologists. But even then the complete solution will not have been reached because we shall still be facing a situation which appears to require one of two things: either the anthropologist must surrender not only his present lightly held opinion regarding the antiquity of man in America, but also his rather more firmly fixed notion regarding the order and progress of cultural traits in general, or else the paleontologist must concede us a very much narrower margin of time as having elapsed since the close of the Pleistocene than he has hitherto.

N. C. Nelson

The American Museum of Natural History

SPECIAL ARTICLES

A NEW METHOD FOR INVESTIGATION OF THE PERIPHERAL NERVOUS SYSTEM, MUSCLES AND GLANDS

In preparing and preserving animals for investigation of the gross anatomy of the peripheral nervous system, muscles and glands, simple methods commonly in use have not proven very satisfactory.

For the study of anatomical structures alcohol does not differentiate sufficiently either to separate the parts from each other or from surrounding tissues. Aside from its cost, moreover, alcohol is open to the objection that it makes the parts brittle. Formalin has been used with better results and is now the standard means employed in preparing, and particularly in preserving, portions of the central nervous system. While both these reagents are preservatives of the peripheral nerves, muscles, and glands, neither is a satisfactory preparative for their dissection.

A successful fluid for this purpose should not only preserve, but it should also differentiate the anatomical systems from each other and bring to view the constituents of the

parts studied, with their relations to the other parts, without disturbing the natural mobility of the tissues as a whole. Such a fluid should reduce the work of dissection so that a minimum of disturbance is necessary in order to reach the parts under investigation.

A most serious objection to formalin is the adhesive effect it has upon tissues, so that parts are not readily separable. Muscles are stuck together in a more or less brittle or fused mass and the nice mobility of tissues observable in a fresh specimen is wholly destroyed. Resultant color changes, too, are such as to make dissection more difficult, for muscles are altered from their characteristic reddish to whitish tints, and it is consequently impossible or exceedingly difficult to trace the smaller nerves to regions of their ultimate distribution.

Formalin adds to, rather than subtracts from, the amount of dissection required, on account of the care necessary in avoiding severance of parts to be left intact.

After giving formalin a thorough trial as an aid for studying the peripheral nervous system it was discarded altogether and the use of fresh specimens employed as a substitute method. But while fresh material is much easier to work upon, the finer nerves are even less distinct than they are after the use of formalin. Moreover, fresh tissues soon begin to deteriorate and the animals become unfit for further use. Pieces of ice kept constantly near, or upon, the material were then tried, with some improvement. Although the animals can be kept for a period of three weeks by resorting to the ice chest, the dissections are not satisfactory. The reason for this is, not only because too much mechanical effort is necessary to segregate the parts, but also because the smaller nerves are not brought clearly to view.

A temporary preservative, and, what is of much more importance, an almost ideal preparative, for the investigation of the peripheral nervous system, muscles and glands, is found in hydrochloric acid.

The fresh animals may be first put in a 5 per cent. solution of *hydrochloric acid ice-water* and left for twenty-four hours. They may be skinned or not, as the problem in hand requires, but the body and chest cavities should in any case be opened to allow the fluid to penetrate through the tissues.

In preparing specimens for work on the cutaneous nerves it is necessary, of course, to leave undisturbed whatever portions of skin are to be studied; otherwise, it is best to remove the entire skin.

After treatment with hydrochloric acid the animals are washed in the coldest water obtainable from the faucet, and put in receptacles deep enough so that the material can be kept covered with ice-water or at least cold water. These receptacles are then stored in the refrigerator when the specimens are not in use.

In using animals so prepared it is found practical to wash them first in running water, leaving the pan partly filled, and then to add pieces of ice sufficient to surround the specimen while observation and dissection are going on. In tracing the smaller nerve divisions, details are brought out better if, occasionally, dilute acid is added, by means of a pipette, directly to the parts under consideration, since by this treatment the transparency of the muscle fibers is increased.

Guinea pigs treated by the above method were found to be in excellent condition for following medullated nerve fibers far into the tissues which they supply.

The 5 per cent. acid solution increases the whiteness of the nerves bringing them into sharp contrast with the natural reddish, or reddish-brown, back-ground of muscles, but if much stronger acids are used, even 10 per cent., it tends to whiten the muscles and dissolve the fibers without improving the color of the nerves.

Animals are also put in good condition for dissection if treated with a 6 per cent. acid solution. If a specimen is to be used during a long period it is better to give an initial twenty-four hour treatment in an acid solution not stronger than 8 per cent. and subsequent immersions in the same strength of acid for shorter periods. In any case the water left

upon the specimen while it is being kept in the refrigerator should be changed at least once a day.

However, the percentage of acid below 6 per cent. may be varied considerably. Indeed, 3 parts of acid to 1,300 parts of water has been found to bring to distinct view cutaneous and other nerves lying near the surface, if the animal is left in the solution three or four days. Interior parts, as the muscles of the eye, then appear reddish, but may be made almost transparent by addition of dilute acid directly to the dissected part as the head lies covered with cold water in the dissecting pan.

Doubtless several factors are involved, in deciding strength of acid to be used. Chief of these is the *size* of the animal, the *nature* of the tissue and the *location* of parts to be studied.

The use of this acid method for investigating the anatomy of various animals, together with the best means of preserving them over long periods, is under investigation and will be treated in a future paper.

In the 5 per cent solution muscles are not only separated from each other but the fiber bundles, of which they are composed, are brought out distinctly, by the breaking down of connective tissue between them. The entire muscle thus made more or less transparent, allows its smaller nerves to appear.

An excellent illustration of the advantage of this transparency was found in the case of the *orbicularis oculi*. After treatment in the acid solution, following the removal of the skin peripheral to the eyelids, little further dissection was needed for study. The orbital and palpebral portions of the muscle, their constituent fibers, with the ramifications and anastomoses of motor and sensory nerves within them, were distinctly observable throughout the breadth and depth of the muscle.

The effect on the muscles of the body wall is such as so to separate the constituent parts and so increase their transparency that the smaller divisions of the nerves within the muscle can be observed at various depths.

Action of the acid seems to continue after removal of the specimen from the solution. In the preliminary treatment, the blood vessels are easily followed and veins can be distinguished from arteries, while anastomoses of blood vessels upon the walls of the alimentary tract, for instance, are brought out clearly. But, as the action of the fluid (5 per cent. HCl) continues for some days, red corpuscles are gradually dissolved and the smaller vessels become less clearly discernible. After a week or so, the inner lining of the stomach wall is loosened from the outer layers of muscle and the latter is broken up into its longitudinal, circular and oblique fibers. Later stages of treatment show clearly the interlacing of the muscle fibers of the heart.

The skeletal parts are found, on removal from 5 per cent. acid, to be decalcified sufficiently to yield readily to cutting with scissors or breaking with forceps, so that the dissection of nerves where they pass through bony channels is rendered easy. On the whole the tissues are broken down so very gradually that a single specimen can be used for weeks.

The most fortunate feature of the method lies in the fact that connective tissue is the first to be seriously attacked by the acid. Much of it remains even to the later stages of dissolution, but appears less dense while its strands become so weak that it is readily separable from parts which it holds together. Nerves and muscles, on the other hand, are about the last of the soft parts to be broken down.

Small unmedullated sympathetic fibers, however, are not favorably affected for dissection by this method and consequently are not as easily traceable as are medullated fibers. That sympathetic fibers are not dissolved by the solution is certain, since the larger ones, and even a few of the smaller ones related to the blood vessels in the orbit, can be traced with accuracy for some distance. This method, therefore, cannot be recommended for study of the sympathetic system, other than of its grosser parts. In such investigations it is decidedly useful, in locating all the larger

ganglia in the body cavity and elsewhere, together with many of their gross connections.

This method has also been proved to be of advantage in the study of glands. Here, again, the breaking down of connective tissue seems to be the chief factor. Glands are thus separated from other organs, the outlines of their lobes come into view, ducts are released from their envelopes and the nerve supply, wherever medullated, can be easily traced. In the study of glands the color effects from this treatment, as in the case of nerves, are helpful to investigation.

It is apparent that a readily applied anatomical method which brings parts to distinct view with little or no dissection is of wide usefulness in embryology. A statement by Professor Mead of the applicability of this method to pig embryos will be found below.

One of the greatest advantages of the method, whether applied to nerves, muscles or glands, is finally to be mentioned, namely, it permits the use of the camera lucida for drawing. It has been found entirely practicable to mount a camera lucida (Abbé type) over the right eye-piece of a binocular microscope and to reduce the field of the left eye-piece by a superposed cylinder 1.8 cm. long, the upper aperture of which is 3 mm. in diameter. This arrangement prevents the observer from shifting the eye to a different view from the one desired and from thus throwing out of position the lines already drawn, as the work proceeds.

S. E. Longwell

Arnold Biological Laboratory,
Brown University

APPLICATION OF THE METHOD TO THE DISSECTION OF PIG EMBRYOS

The method here described by Mr. Longwell has proved to be very valuable in preparing pig embryos for general dissection. Embryos from 12 mm. to nearly full term were treated with about 1 per cent. HCl and either kept for 2 or 3 days in the refrigerator or, when weather was cold, out of doors and sometimes frozen. In some cases they remained in the refrigerator for a month. Some of the specimens were dissected immediately after rinsing the acid off with water and others were kept in about 1 per cent, solution of carbolic acid.

The treated specimens retain nearly the texture and pliability that they had when taken from the uterus. The muscles are rendered slightly more opaque rather than transparent as in the guinea pigs prepared by Mr. Longwell. The nerves, therefore, do not present the striking contrast to muscles in color which his specimens show. In case of the embryos, however, the slight opacity of the muscles is rather an advantage.

The advantages of the method as applied to the embryos are the complete lack of rigidity or brittleness, the extraordinary ease with which the adjacent parts can be separated when the connective tissue is partly dissolved. The epithelium separates from the true skin and the latter from the superficial fascia with the greatest ease. The skin muscles, for example, the platysma and facial and auricular muscles, show with diagrammatic clearness. The deeper muscles retain sufficient strength for purposes of dissection. The nerves retain their strength entirely and are white. It is easy to follow them to their minutest branches. The cerebrospinal and sympathetic ganglia are also tough.

The facility that the method lends to the dissection of embryonic glands and ducts is equally delectable. The ducts of the submaxillary and parotid in a pig of 100 mm. can still be followed to their ultimate branches. The liver becomes soft but when pinched between the fingers and washed the branches of the vessels, the gall bladder, cystic and hepatic ducts, etc., are left and the relation of the omenta and the foramen of Winslow are most satisfactorily exposed.

Tendons, fascia, the peritoneum, blood vessels and meninges retain sufficient toughness for satisfactory dissection. The brain and cord are of better texture and color than in either fresh specimens or those prepared in formalin or fixing agents followed by alcohol.

In general Mr. Longwell's method is invaluable in the dissection of pig embryos.

A. D. Mead

SCIENCE

FRIDAY, APRIL 26, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME DEVELOPMENTS IN THE CHEMICAL INDUSTRIES AS A RESULT OF WAR CONDITIONS[1]

IN these passing days every branch of scientific activity has many striking illustrations of the fact that its fund of knowledge and experience is being vigorously drawn upon to meet the pressing needs of the hour. Where so many sciences are making notable war records it may seem invidious to select any single one for review. But my own personal apology must be that I have not the ability and certainly a single evening has not enough hours for presenting the activities and the accomplishments of the entire field of science. While, therefore, we are proposing to discuss matters having a more or less chemical tinge it should be emphasized at the outset that we are not unmindful of the wonderful service in manifold ways resulting from the activities of the physicist, the engineer, the geologist, the bacteriologist and botanist, the psychologist, the pathologist and sanitarian: All these and many other workers in related branches of science have achieved results which are quite as fundamentally important as anything the chemist may have to offer.

A further word of explanation or possibly of warning may also be in order. The field of the chemist is so wide and his activities touch so many interests that sometimes he must be not altogether certain himself when he is treading the paths that lie outside of his own borders. Indeed he must appear occasionally, in the mind of other people, at least, to have adopted as his own the

[1] Annual address delivered before the Society of Sigma Xi, University of Iowa, February 13, 1918.

line from Kipling, which runs, "Yours is the earth, and everything that's in it." This must be the explanation, therefore, if we seem to discuss some topics where the chemical connection is but dimly discernible or possibly lost entirely.

In the first place then, let us discuss the fuel problem, that is to say coal:

It has seemed to take a war situation to shake us into a realization of the fundamental and elementary fact that coal transportation must be evenly distributed throughout the year and not left to the congested conditions of the winter months. We talk about a fuel famine due to car-shortage. It is not a shortage of coal cars that troubles us—but rather a shortage of the thinking process in connection therewith. What indeed is a car shortage? You say it is the opposite of having cars enough. Now if we mean, by an adequate railway equipment, enough cars to serve the mines and move the coal to accord with the abnormal demand of the winter months, no railroad in this country now has, or ever can afford to have, such an equipment. Mr. C. G. Hall in 1914, while Secretary of the International Railway Fuel Association made an estimate to the effect that if we were to take only five of the leading coal-moving roads of Illinois and Indiana and calculate the additional equipment they would need in order to fully serve the mines and meet the current consumption of the winter months, these five roads would require 250 additional locomotives and 30,000 cars representing, together with the necessary additional trackage and yard equipment, an expenditure of approximately \$75,000,000. This would represent for this small group of railways alone, a fixed charge in the way of interest, amounting to nearly \$4,000,000 per annum, with the extra equipment standing idle and non-productive for eight months of the year. Indeed, he goes further and estimates that the railways of the country already have in service coal cars over and above the number that would be necessary if the same tonnage could be handled at an even rate throughout the year, and such excess equipment represents an investment, even under existing conditions, of over \$105,000,000.

But all of these features were in evidence before the present war. They still exist in even more pronounced degree, with a number of added features. We talk of eating less wheat so that our Allies may have more bread, but we ought also to have put in our coal supplies last August so that in January the war necessities and the fuel needs of our Allies might have a better chance at the coal pile. I am just in receipt of a letter from one of my colleagues who left the laboratory about four months ago. It was written in Paris and I quote a sentence or two: "We have plenty to eat but the amount of radiation allowed is very small. If I had as much coal here as I had in my cellar at home I would be arrested for hoarding. Coal is actually \$70.00 per ton." The point of the whole matter is this: We must learn the art of storing coal. It is not the railroads alone that are concerned. The miners and coal operators are equally involved. Under the present system the mines are operated on an average about 200 days in the year. Such a system must have a demoralizing effect upon labor, so that many serious social as well as economic and financial questions are involved.

And where now does the chemist come in? I was passing through a neighboring town about the middle of last September and saw along the railway tracks a coal pile of about 30,000 tons, burning too fiercely to be quenched or moved and as a result the entire lot was a total loss. Other similar fires have been reported, among them the

firing of a pile of 100,000 tons at Superior, Wisconsin.

A number of chemists and engineers have been quite diligently at work for a number of years on this problem of the storage of coal, and the interesting point is that these results are now available in such form as to furnish a practical contribution to this very important problem and it is certainly an opportune time for this work to have been completed. The summary of it all seems to be:

First: That coal can be stored in large masses with a very fair degree of safety from spontaneous combustion, and

Second: That the loss of heat values due to weathering or other deterioration processes is practically negligible.

As confirmatory at least of the first of these conclusions the case may be cited of a large power and lighting concern which for some time has been putting in practise the principles involved in the proper storage of coal and indeed had a very considerable stock on hand. During the recent freight embargo due to weather conditions this company was able to continue its service without interruption by drawing upon its reserve supplies. Only an occasional car of coal was received from the mines by this concern for 30 days immediately following the 5th day of January, 1918. What this meant to the operating end of the system and the community which it served may be realized when it is known that the fuel demand of their boilers amounted to from 6,000 to 7,000 tons per day. Here in fact was a storage supply that could be drawn upon and was drawn upon to the extent of over 200,000 tons. The practicability of storing western bituminous coals was thus strikingly demonstrated. The chemists have worked out the fundamental principles involved. It is up to the engineers to apply them. The storage of coal having been shown to be possible it at once becomes an industrial as well as a war measure of very great importance.

Not greatly distant from the coal question is the subject of coke. We can not win wars without iron and we can not make iron without coke. Previous to 1914 the by-product method of coke manufacture was making steady but slow gains upon the almost criminally wasteful process as carried out in the bee-hive oven. Approximately 75 per cent. of all the coke produced in the United States came from bee-hive ovens. For the current year, 1918, it is estimated that the by-product ovens will produce 50 per cent. of the total yield. Something can be understood as to the magnitude of this change when it is recalled that an equipment of bee-hive ovens can be built and put into commission for a few thousand dollars while for a by-product equipment the cost is hardly less than from $3,000,000 to $5,000,000. It is doubtful if anything has occurred during the last four years that will more profoundly affect our industrial activities than this revolution in our coking process. In the old bee-hive oven all of the volatile constituents of the coal were burnt and lost unless we count the heat produced as having some value in the formation of the coke. But that procedure was like burning up five dollars' worth of high-grade material to produce five cents' worth of low-grade heat. The only product of the bee-hive oven was coke. In the by-product oven the coke has almost come to be the by-product while the volatile or liquid material might be looked upon as the item of chief interest. For illustrating a point a little further along it will be worth while at this point to mention a few more important of these constituents. We will not stop to name them all, since potentially at any rate, their number would be about 7,000.

There is, then, gas, for the city mains, ammonia for fertilizers and munitions, benzol for colors, toluol for explosives, phenol, being just plain carbolic acid, for antiseptics, explosives and phonograph records, creosote oils for the wood preserver, anthracene for more colors and then just plain tar. This enumeration brings us directly to a discussion of the coal-tar dye industry.

Three years ago we were being warned that the foreign dyes would soon be exhausted, that none were made in America, that the men would have to wear white socks and neckties to match, and that gaily colored ribbons and dress patterns for the ladies would have to be forgotten. All of which delectable information was accompanied by the query, "What is the matter with the American chemist?" A number of thoroughly well informed among the brethern made reply which in substance set forth the fact that the American chemist was all right and just as competent as any other chemist in the matter of dye stuffs, but with much emphasis, they set forth the very pertinent fact that as a manufacturing proposition it required large capital. That the business was interrelated and interwoven with so many subsidiary lines that all must be built together in order that any one feature could succeed. The complete circle of establishments and processes needful for embarking in the industry is well suggested in the short list of by-products already given. Now they estimated that on the most conservative basis, the capital needed to start the dye industry could not be less than ten million dollars and what was more, the experience of a former attempt to establish the industry in this country resulted in almost complete industrial wreckage of the business caused by the dumping process from German factories. A financial record of this sort made the prospect of interesting large capital impossible without protection. Because there was at the time a total lack of protective legislation it was argued that the same disastrous experiences would result, so the chemist passed on the question and referred it to the capitalist and Congress with emphasis on the fact that it would take both legislation and money to establish an American dye industry. And so the matter rested quiescent and was almost forgotten.

A few days ago I hapened to be passing through one of the largest department stores in Chicago and indeed of the world. My route, purely by accident of course, took me past the dress goods and ribbon counters and also through the division where neckties and socks were displayed. The profusion of colors on every hand recalled quite vividly some of the predictions of three years previous and I made mental note of the confirmation of numerous facts, which have been coming to the surface, relating to the development of the dye industry in this country. These facts are doubtless familiar enough to the chemists, but so quietly has the work gone along and so little has been said about it outside of chemical circles that a brief reference may not be amiss at this time.

Four years ago the firms in this country engaged in the manufacture of dyes and intermediates or accessory substances numbered all told about six, mostly in fact importation houses. Only two or three of these were of even moderate size or had any great amount of capital invested. At the present time there are not six nor sixty nor twice sixty, but 130 such corporations actively engaged in the business. The capitalization of these concerns, previous to about October 1 of last year, was stated to be approximately $150,000,000. Since that date the Dupont Company has announced its intention of entering upon the manu-

facture of dyes and associated chemicals. The especial amount of capital to be set aside for this purpose does not seem to be stated. It is perhaps sufficient to know however, that the capitalization of the Dupont Company amounts to $240,000,000. As for legislation, that matter has been fairly well attended to, so that piracy and financial submarine warfare would seem to be eliminated.

And now what about the chemical part of it? Previous to 1914 the importation of dyestuffs into this country amounted to a little over 10 millions dollars per year. The home production was insignificant even for our own use and the exportations were conspicuous by their absence. During the year 1917 we had caught up with the production of dyestuff to such an extent that the output was sufficient to meet all home demands with possibly one exception, namely, the manufacture of indigo blue which had been so largely contracted for to meet the needs of the United States Navy that there was as yet no surplus for the general trade. This does not mean that all of the possible 1,000 formulas representing that number of different dyes and which were available before the war are now made in this country. It does mean, however, that the possible 100 dyes called for by the everyday work of the dyer and meeting substantially all of his needs are at hand.

Such an accomplishment would not have been thought possible even by the wildest dreamer two and a half years ago and in itself would be quite sufficient cause for profound congratulation to all concerned, chemists, capitalists, the ribbon counters and the ladies, but that is only half and less than half the story. In addition to being able to supply our own needs the exportations to other countries for the first ten months of 1917 amounted to a total of $12,500,000 and if the exports for December last are an index for the current year, the dyestuffs sent abroad from this country in 1918 will reach a total value of over $16,000,000.

Permit me further in this connection, to paraphrase an old exclamation, "That beats the Dutch!" by saying "This beats the British," because early in 1916 it was announced that there had been formed in England and British Dye-stuff Syndicate, backed financially to the extent of about $15,000,000 by the manufacturers of dyes, the textile industries and the government, with the avowed purpose of making themselves self-contained and independent of foreign supplies. Of course the English people are tremendously busy with other things and there is no thought whatever of reflecting on their ability to accomplish what they set out to do in this *or any other undertaking*, but it is interesting to know that our largest customer last year was Great Britain, whose purchases of dyes exceeded a value of $3,000,000.

Before leaving the subject of dyes, it may not be out of place to mention a circumstance, involving, perhaps, too much of detail or possibly of personal interest to be included in this discussion. However this is the item: About eighteen months ago a chemical graduate from one of these land-grant colleges which we now dignify with the title of state universities, one of my own students in fact, completed his investigations in a government laboratory upon the possibilities of a dye which he had developed from the wood of the osage orange. The results of this work are now almost everywhere in evidence, because of the utilization of this dye as the coloring matter for the khaki uniform cloth of the American army. I wonder if his acquaintance with the osage orange does not result directly from its introduction, throughout the upper Mississippi Valley, some fifty

years ago by Professor Jonathan B. Turner, the father of these same state universities, the educational prophet of the generation preceding our own and the personal friend of Abraham Lincoln, the weight of whose influence and whose signature to the Morrill bill in 1862 made possible the founding of these universities, may we not say, of the common people.

Intimately associated with the coal-tar dyes is the subject of munitions. Some months ago in conversation with the chief chemist for one of the largest munition plants of the country, the question was asked if he was able to keep reasonably busy these days, at least so that Satan could not readily find some mischief still for his idle hands to do. His reply was significant and made without note or comment. It did not need any. He said our total output of explosives at the present time amounts to a million pounds per day. Of course a very large part of this output is used in mining and blasting, but the aggregate of high explosives, which before the war was insignificant, now approximates something over two billion pounds per year.

The substances from which the three main types of explosives are made are glycerine, phenol and toluol, but the greatest of these is toluol. Where are we to get the toluol? The question has been partly answered in the great increase of by-product coke ovens. But if twenty million tons of coke are made in these ovens during the current year and the yield of toluol is one half gallon per ton then we only have in sight from this source about ten million gallons of toluol, only about one quarter of the amount required for making the munitions needed for our own army. But the call has already gone out for "toluol and more toluol." The first measure to meet the demand, and which is now being inaugurated, is the stripping of city gas of this material. It can be spared without any great detriment to the gas and amounts to approximately .04 of a gallon per each 1,000 feet of gas. Ten of the largest cities of the country where this process is to be first installed are estimated to yield approximately an additional 10,000,000 gallons. However, the problem is really in process of solution. It is an extremely vital question, and is causing anxiety in some quarters but it will doubtless be met and answered in good time.

It may be interesting to note in passing that for each gallon of toluol, there is produced from five to six gallons of benzol.. Even now this material is being produced in such quantities that the usual channels for its use are more than satisfied. This primarily has a bearing on the dye industry since it forms the starting point for the largest part of the dyes. But benzol has now come to be the starting point for the manufacture of carbolic acid and carbolic acid, or phenol, is the starting point for picric acid, another explosive, and also for the manufacture of Bakelite, which has almost completely replaced gutta percha in electrical appliances, and then, coming nearer home, it is Bakelite which furnishes the material for the manufacture of phonographic records. One more possible adaptation of benzol is of interest. It is miscible in all proportions with alcohol and when so mixed furnishes a motor spirit in some respects superior to gasoline. Indeed a well-authenticated report seems to indicate that about 70 per cent. of the motor spirit used in Germany at the present time is made up of this material. These various items will serve at least to show the interrelated character of the very large and important group of interests which are associated with and grow out of the coking process. But time would fail me

if I attempted a mere enumeration of all the interesting developments connected with the coking of coal.

As for gasoline, the output last year exceeded two and one half billion gallons. But that is not enough. The current year will probably see this amount increased by possibly 10 per cent., through the extension of the stripping of the condensable material from natural gas and from the extension of the cracking process, especially the method now developed to such a practical stage by Dr. Burton, of the Standard Oil Company.

And what about potash? We are told that the production for 1916 was ten times what it was for 1915, but that does not mean much, for we made less than 1,000 tons in 1915. The output for the current year will doubtless exceed 40,000 tons, but even that loses much of its significance when we remember that our previous importations from Germany amounted to about 275,000 tons per year. But recent, almost monthly developments are exceedingly interesting and encouraging. There is first the brines, especially of western Nebraska and southern and southeastern California. This is at present by far the largest source. Then come the Kelps of the Pacific coast, still in the developing stage but moving rapidly and encouragingly—and then come the alunite deposits of Utah, a real producing proposition, but relatively as yet on a limited scale. We are just beginning to get glimpses of the possibilities from cement furnaces, from the green sand of the Eastern States and from the feldspars in widely distributed localities. At the present rate this problem seems in a fair way of solution.

And meantime what of the industries using potash, for example in glass manufacture? Soon after the outbreak of the war, the chief chemist for one of the largest glassmakers of the country was asked what he was going to do for potash. His reply was that he had for some years urged upon his firm the advisability of experimenting with soda as a substitute for potash, but they insisted upon "letting well enough alone." But now since they were obliged to try it by force of circumstances they were so well pleased with the results that they would not return to the use of potash even should it become again available.

Similarly the gold miners were distressed to know where their supply of potassium cyanide was to come from when importations of potash salts ceased. At the Secoud Chemical Exposition at New York in 1916 one of the large chemical concerns had on exhibition some fine-looking sodium cyanide. The question was asked how it was working out. The reply was that it was proving advantageous over the potassium cyanide in numerous ways. It had a higher percentage of the active principle per unit of weight, was cheaper to manufacture and they would not return to the use of potassium salt even should the supply of potash again become available.

Again, take the crucible situation. The manufacture of graphite crucibles is an exceedingly important one to practically all of the metallurgical interests, from steel to gold. The clay used in their manufacture must be high grade and possessed of special properties. It all came from a particular locality in Germany. The stock in hand of that material lasted about a year. Meanwhile a vigorous search for substitutes had been going on. The first of this new material was put out about two years ago, the shipments of these crucibles bearing a tag which constituted a sort of apology, stating that the supply of foreign clays had become exhausted and asking for some care and some indulgence if the

quality of the new crucibles was found to be not quite equal to the old.

I have myself had occasion to use these new crucibles under quite as exacting conditions and certainly under quite as high and probably higher temperatures than those commonly employed. My conclusion is that the manufacturers should now send out these wares with a new label, which would be in effect an apology for the first apology and say, "These crucibles are made in America, of American clays and we take pleasure in guaranteeing their superiority over anything formerly manufactured from foreign material."

Then there is optical glass. It all came from Germany. In their own experiments in attempting to develop a high-grade optical glass the Germans published to the world the results of their experiments for about ten years. When they began to get valuable results the government stepped in and there has been an impressive silence for the years following. At least no one outside of Jena seemed to know how to do it. The French and English each had a single factory which was making a good glass but all of their output was needed at home and was at once commandeered. Here then was an immediate and imperative need, for both the navy and army must have range finders, field glasses, cameras and telescopes without number. The problem was taken up by the government laboratories and by scientific calculations and deductions coupled with skillful experimentation they are now able after ten months to produce not only a better but a greater variety of optical glass than the Germans had been able to produce in ten years.

And now just a word about nitrates. When we note the mere names of the explosives manufactured it is apparent that they are all nitration products and that nitric acid is an essential in the making of every one of them: Nitroglycerine, Nitrocellulose, trinitrotoluol, trinitrophenol, ammonium nitrate and even the niter in the old style of black powder confirms this fact. Nature, it seems, has been very partial in her distribution of nitrates in quantities to be at all worth while, Chile alone being the fortunate country. But with four fifths of the air nitrogen, one ninth of the water hydrogen and all the rest of both being oxygen, we at least can be said to have the raw material in sight, or perhaps better, at our very doors, at all times. No wonder the question is being rather nervously asked, "What are we doing to insure an adequate supply of nitrates?"

As a protective measure, while we are doing our thinking the government is spending $35,000,000 on reserve supplies from Chile, but already Professor Bucher, of Brown University, and the chemists of the General Chemical Company each along separate lines has developed successful processes for the manufacture of ammonia, the present most effective starting point for the manufacture of nitrates and nitric acid, so that already work has begun on the establishment of a plant at Sheffield, Alabama, capable of producing 60,000 pounds of ammonia per day. Germany, of course, has been doing her own developing, for it is assumed that she did not have a stored-up supply of Chile saltpeter sufficient for more than about a year, but it is now evident that we will out-nature nature and incidentally out-Germany Germany since we have in sight for the coming year the certainty of meeting all of our needs in this line.

But almost everything chemical requires sulfuric acid. Indeed this acid is said to be the index finger which points out the chemical activity of a country. The finger for 1917 indicated that the manufacture of sulfuric acid of all strengths for 1917

amounted to five and one half million tons, an increase over 1916 of over 600,000 tons. Now recall that all of the nitration processes above referred to in the methods of manufacture of explosives employ nitric acid primarily and also sulfuric acid as an accessory to the deed, as the lawyers might say, and the further fact that a total of over two billion pounds are made per year at the present time. This is nearly 300 times the output in 1913 and over half of it is exported. Now the question is, "What sort of apparatus can stand up in use under the action of these acids, especially in the manufacture of these enormous quantities of explosives?" The answer has been worked out and can be fairly well read in the advertisements in the chemical journals of "Duriron," "Tantiron," "Buflocast" and so forth. Five years ago we were familiar with what by comparison might be termed toy samples of apparatus made from this material. To-day the magnitude of the apparatus made takes on really huge proportions. One might almost say that some of them would house a coach and four. We can now understand, I think, a remark made at the second Exhibition of the Chemical Industries held in New York in 1916. A professor in one of our oldest universities in passing by the various exhibits, stopped in front of the display showing the various forms of Duriron. After a moment's pause he remarked impressively, "Ah! it is this which has saved England."

And so we might go on almost ad infinitum. But the time would fail me to tell of magnesite, an essential for high temperature furnace linings, formerly all imported from Austria and Hungary, now produced in California and Washington more than enough for our own needs. Of rare and unusual chemicals such as dimethylglyoxene, heretofore only "made in Germany," an indispensable reagent for analytical work with nickel steels, of photographic materials, of remedial agents and synthetic drugs such as novocaine, a local anesthetic of great value: of thermometers and graduated ware, of glassware and porcelain equal to the best of former importations. The chemists of the country seem to have been awake at the switch and I think we must agree that they have been singularly effective in their work.

I would like to discuss for a moment some of the underlying causes which I believe have been of fundamental importance and largely responsible for this effectiveness. The mere enumeration of the above items is informational and may even be interesting, at least to the chemists, but to my mind it should serve an additional purpose of even greater importance. It seems to me therefore that we may well devote the few minutes remaining to pointing a moral and making the attempt at least of furnishing a little adornment to the tale.

The great underlying fact which must be evident to any one who digs but a little way below the surface in seeking an explanation for the success of the chemists is this: The most pronounced advancements of the art, the real achievements, that have, with such seeming readiness and almost as if by calculation promoted these strikingly successful results have been brought about by men of thorough training in the purely scientific principles of their art. Here in the universities of the country has been going on in a quiet way for fifteen or twenty years past a type of preparedness which I believe may be worth our while to study.

The method of training the chemist is almost uniformly on the principle that if you are going to make a scientist in the field of chemistry, then surely he must know the science of chemistry and if you

are going to make an applied scientist in the same field, he must still know the science before he can have anything to apply. It is not possible, at least it is not possible any more, to make a rule-of-thumb chemist and turn him out to practise what in his case could only be a black art.

You say that chemistry lends itself especially to this method of procedure, but it is not different in this respect from the other sciences. There is no greater truth in evidence in all of the sciences than this, that the men who are accomplishing things are the men who have had the training in the theoretical as their real preparation for the practical ends which they are to accomplish. The state universities were founded immediately at the close of the Civil War almost before the noise of battle had died away. It is not strange that the provision was made that attention should be given to military instruction and so that sort of preparedness has been going on through all the years since. Nor am I belittling its value, for I believe in it thoroughly, but in its relation to the real preparedness of the country the value of that work shrinks almost to the zero point in comparison with the quiet, undemonstrative but effective training in the sciences that has been going on in these same universities. We have heard not infrequently and indeed seen it demonstrated that you can make a soldier and an army if you have to in two years, but it takes twenty years to make a scientist and there is no fact that stands more clearly demonstrated to-day than that for great emergencies you must have a vast number of scientifically trained men and there is not a little satisfaction in the further fact that they are equally good material to have around either in peace or in war.

If our own system of education in the sciences and their close linking with the industries is not sufficiently convincing, turn for a moment to Great Britain. At the opening of the war their eyes were suddenly and most distressingly opened to the opposite aspect of the picture. They had been sailing the seas and trading in goods and had left the bulwark of their technical industries, their men trained in the sciences, altogether too largely to wear also the label, "made in Germany." This is not my criticism. To the credit of the Britisher be it said that when he sees the truth he is not afraid to speak it. In this matter he has been his own relentless critic. Read some of his conclusions: H. E. Armstrong in an address before the British Association, August 1914 (*Nature*, 94, p. 213) refers to Huxley, who in 1861 pronounced these prophetic words:

> Physical science, its methods, its problems and its difficulties will meet the poorest boy at every turn and yet we educate him in such a manner that he shall enter the world as ignorant of the existence of the methods and facts of science as the day he was born. The modern world is full of artillery, and we turn our children out to do battle in it, equipped with the sword of an ancient gladiator. Posterity will cry shame on us if we do not remedy this deplorable state of things. Nay, if we live twenty years longer, our own consciences will cry shame on us.

Professor Armstrong proceeds,

> Now after more than fifty years, not twenty merely, we still go naked and unashamed of our ignorances; seemingly there is no conscience within us to cry shame on us. I have no hesitation in saying that we have done but little through education to remedy the conditions of public ignorance which Huxley deplored. In point of fact he altogether underrated the power of the forces of ignorance and indifference; he failed to foresee that these were likely to grow rather than fall into abeyance.

Sir Ronald Ross, in *Nature* for 1914, p. 366, says this:

> The war now raging will at least demonstrate one thing to humanity—that in wars at least the scientific attitude, the careful investigation of details, the preliminary preparation, and the well

thought-out procedure bring success, where the absence of these lead only to disaster.

You will remember that an attempt to remedy this situation resulted in the organization of an advisory board composed mainly of eminent scientific Englishmen to cooperate with a committee of the Privy Council. An editorial in *Nature* for 1915 says of this scheme:

By its inception and publication the government acknowledges and proclaims its appreciation of the work of science, and by this acknowledgment alone gives scientific workers that encouragement and prestige in the eyes of the country which has too long been withheld.

May we not venture to note that in our own land this propaganda on behalf of science has been active and indeed effective through the work of our universities for so many years that we have almost forgotten the early struggles of the advocates of this type of educational work.

I have said that it takes twenty years to make a scientist. We often hear it said that graduation, after four years of study, is only the commencement of things. This is nowhere more true than in the case of the sciences. Real effective training in these lines does not come and can not come except as a result of application and toil and devotion and the intensive training which accompanies research work. See how wise the great industries are in this respect. How their research departments have grown in number and what a corps of thoroughly trained and theoretically trained men they have put in charge. And not the pity of it but the danger of it is that they are drawing upon our universities for their best and strongest men to direct and develop their work. How long and to what extent will it be wise to allow these inroads to be made is a serious question, which perhaps can wait awhile for settlement. The immediate and pressing obligation now is to continue without let or hindrance in the task of training men even more profoundly and thoroughly in the fundamental theories of the various sciences. To the universities, to the Sigma Xi and to scientists everywhere this situation ought to come as a call to the colors. Yours is not the glamor or the pomp and circumstance of war but you have the goods, and your quiet and steadfast continuance in the work of scientific development has in it the very essence of patriotism. Your satisfaction and compensation must come from the witnessing on every hand and from every line of scientific endeavor to the inestimable value and far-reaching influence that flows from your work.

The industrial world to-day not only welcomes but demands this type of trained men. Their reception to-day as they leave the universities is in marked contrast to what it was twenty-five years ago. I recall an editorial in one of our metropolitan newspapers, written just at the time of year, a long time ago it seems now, when the universities were sending forth their quota of graduates. Their inexperience and unadaptableness to this worldly world was expanded and more or less flippantly dwelt upon under the caption, "What can they do?" In any review of what this type of the genus homo is doing to-day in medicine, in surgery, in sanitation, in food products and food production, as seers, as prophets, as wizards, if you please in unraveling and setting in order and at our disposal the material things of the universe, granted as I have already said that they be given the necessary opportunity for aftergrowth in lines of study and research —there seems to come an echo from that old-time newspaper dissertation which calls for another article in quite a different vein and indeed whose purpose would be to set out in their proper perspective the work of these same university products. The

proper and fitting caption of such a dissertation, it seems to me, would be "What can they not do?"

Fellow workers, companions in research, I profoundly believe that research must mean a different thing after we are through with these passing days of frightfulness. It was counted upon by Germany as her greatest asset. It must prove to be America's bulwark of defense. It has been sufficient in the past that your impulse has been the search for truth for truth's sake. It is inevitable that that impulse must now be raised to an inspiration with a very passion for truth for humanity's sake. As you have worked unwittingly, but none the less effectively for preparedness, so may it be your part to work unremittingly and with equal effectiveness towards the building again of the temples of peace, to turning the dark clouds inside out and contributing to the greater successes of a better day.

S. W. PARR

UNIVERSITY OF ILLINOIS

THE NEW HOPKINS MARINE STATION OF STANFORD UNIVERSITY

THE project of the development of a marine biological laboratory in connection with Leland Stanford Junior University owes to its origin to Professor Charles Henry Gilbert and Professor Oliver Peebles Jenkins. Recognizing the value and importance of such a foundation, they set actively to work during the first year (1891) of the University to secure its realization. After a careful examination of various sites along the coast, Pacific Grove, upon the southern side of Monterey Bay, was selected as combining the most desirable features. Through the generous cooperation of the Pacific Improvement Company a suitable site and a sum of money sufficient to erect the first building was donated. A plain two-story frame structure, twenty-five by sixty feet in ground dimensions was erected on Point Aulon, a low rocky headland, and the first session of the new laboratory was held during the summer of 1892. In recognition of the active interest and liberality of Mr. Timothy Hopkins the station was named the Hopkins Seaside Laboratory. Funds for the purchase of books and equipment were provided by him from time to time, and in the following year he erected a second building. The two buildings contained four general laboratories, a lecture room, seventeen private rooms, and a large concrete basement for special physiological work. The salt-water piping for the aquaria in the second building was constructed of pure block tin throughout, with hard-rubber stopcocks.

During the first twenty-five years of its existence the laboratory while nominally a part of the university and freely using its library and apparatus, was dependent for its upkeep and extension chiefly upon student fees and private gifts, the latter mainly through the constant sympathetic interest of Mr. Hopkins. Despite these limitations it offered its facilities to many investigators and students during that period, and contributed materially to the solution of biological problems on the Pacific coast.

With the passing years it became increasingly evident that the site upon Point Aulon was inadequate to the needs of the laboratory. In 1916, through the efforts of President Wilbur and the Board of Trustees, a new location was secured nearly five acres in extent and comprising the main portion of Almeja or Mussel Point, situated a half mile eastward of the old site. This point will be recalled by former visitors to the Seaside Laboratory as that upon which the fishermen of the picturesque "Chinatown" used to dry their large catch of squids. Chinatown disappeared in a blaze about fourteen years ago, and was never rebuilt. The new situation insures complete control of the coast line of the point, including an excellent sheltered landing place and harbor for boats of considerable size (used in the old days by Chinese fishermen).

Close to this cove the first building of the new station was erected during 1917. It is of reinforced concrete construction approxi-

mately forty-one by eighty-four feet over all and of a height of three stories. On the ground floor is a physiological laboratory, twenty-three by thirty-nine feet, containing a large floor aquarium of cement, six by fourteen feet, a private laboratory, ten by eleven feet, also a concrete-floored room twenty-three by thirty-nine feet for sorting collections, and for the storage of boats, collecting apparatus, etc. There are, besides, a large storeroom, furnace room, janitor's room, photographic dark room and men's lavatory.

The second floor, into which the main entrance opens, is devoted to the three large general laboratories, two of them approximately twenty-three by thirty-nine feet, the third twenty by thirty-six feet, and accommodating each twenty-eight students. Two private laboratories for instructors are also provided on this floor.

The third floor contains a large library with a generous fireplace, an adjoining room for records, an advanced laboratory, twenty by twenty-two feet, six commodious private laboratories for investigators, and a rest room for women. Fresh and salt water are supplied to each laboratory, the sea water being pumped to a concrete tank on the roof, whence it is distributed to the various double-decked, cement aquarium tables. Heating is provided by a hot-air system, electric lights are installed, and gas soon will be. From the third floor a stairway gives access to the flat, parapeted roof, where open air aquaria may be set up as needed. There are thus five laboratories available for classes and nine private laboratories for investigators. The private rooms have much the same equipment as that used at the new Woods Hole Marine Biological Laboratory.

The plans for the Station are very largely the work of Professor Frank Mace McFarland, of the Department of Anatomy, in conference with Professor Charles Henry Gilbert, of the Department of Zoology.

In fitting recognition of the aid rendered by Mr. Timothy Hopkins during the whole life of the Station, the Board of Trustees of the university named the new institution on October 26, 1917, the "Hopkins Marine Station of Stanford University."

The Hopkins Marine Station fulfills a two-fold function: first it furnishes under exceptional natural advantages elementary and advanced instruction in biology, second, it provides for research work. Beginning June 15, 1918, the Station will be open the entire year, the Director being in residence. Investigators and special students can be accommodated at any time. Regular classes are scheduled for the spring (April 1 to June 18) and summer (June 19 to August 30) quarters only. As formerly, the use of Station facilities is tendered to investigators free of charge; students are required to pay a small fee.

The Station is an integral part of Stanford University, controlled by the board of trustees, the president, and the academic council in the same manner as other departments of the university. In addition there is a small committee of the faculty exercising advisory and to a certain extent executive functions. The staff consists of the director and those members of the faculty who offer regular courses of instruction at the station.

The extraordinarily rich fauna and flora of the Monterey Bay region offer exceptional opportunities to investigator and beginning student alike. There are a surprisingly large number of marine animals and plants readily accessible. The student of land forms will encounter a varied assemblage of species, since there are very few regions of equal extent which offer such a curious combination of widely diverse ecological formations. There are probably a greater number of endemic plants than in any other similar continental region. Investigators in the fields of general experimental work, taxonomy, anatomy and embryology will find a wealth of material to chose from, while those concerned with a study of animals or plants from the special standpoint of their "marineness" will naturally be exceptionally favored.

During the summer quarter (June 19 to August 30, 1918) courses will be offered as follows: General Zoology, by Professor E. C. Starks; Economic Zoology (Marine Inverte-

brates) and Invertebrate Embryology, by Professor Harold Heath; General Physiology and Research in Physiology, by Professors E. G. Martin and F. W. Weymouth; The Algae and an advanced course in Botanical Survey, by Mr. J. I. W. McMurphy.

President Wilbur has appointed W. K. Fisher, of the Department of Zoology, director of the station.

W. K. Fisher

SCIENTIFIC EVENTS

THE BOMBARDMENT OF PARIS BY LONG-RANGE GUNS

Professor G. Greenhill writes in *Nature* that the Jubilee long-range artillery experiments of thirty years ago were considered the *ne plus ultra* by the British authorities, and were stopped at that, as they were declared of no military value. But the Germans are said to have watched the experiments with great interest, and to have carried the idea forward until it has culminated to-day in his latest achievement in artillery of a gun to fire 75 miles and bombard Paris from the frontier. Professor Greenhill writes:

From a measurement of the fragments of a shell a caliber is inferred of 240 mm., practically the same as the 9.2 inch of our Jubilee gun, which, firing a shell weighing 380 pounds at elevation 40°, with a muzzle velocity nearly 2,400 feet per second, gave a range of 22,000 yards—say, 12 miles. This was much greater than generally anticipated, but in close agreement with the previous calculations of Lieutenant Wolley Dod, R.A., who had allowed carefully for the tenuity of the air while the shot was flying for the most part two or three miles high.

The German shell is likely to be made much heavier and very nearly a solid shot, better by its weight to overcome air resistance, the chief factor to be consdered in the problem of the trajectory. If it was not for this air resistance a range of 75 miles with 45° elevation could be reached, on the old parabolic theory of Galileo, with so moderate a velocity as $V = \sqrt{(gR)} = 3{,}200$ feet per second, with $g = 32.2$, $R = 75 \times 5{,}280$; in a time of flight of about 2½ minutes, an average speed over the ground of 30 miles per minute.

A velocity of 3,200 feet per second was obtained by Sir Andrew Noble in his experiments at Newcastle about twenty years ago with a 6-inch 100-caliber gun, with a charge of 27½ pounds of cordite and a shot of unspecified weight, so it may have been the usual 100 pound or perhaps an aluminium shot of half the weight.

Double velocity is usually assumed to carry twice as far; at this rate the velocity of our gun would require to be raised from 2,400 feet to about 6,000 feet per second to increase the range from 12 to 75 miles; such a high velocity must be ruled out as unattainable with the material at our disposal.

But in this range of 75 miles the German shot would reach a height of more than 18 miles and would be traveling for the most part in air so thin as to be practically a vacuum, and little resistance would be experienced.

So it is possible a much lower velocity has been found ample, with the gun elevated more than 45°, for the shot to clear quickly the dense ground strata of the atmosphere. Even with the 3,200 feet per second velocity obtained by Sir Andrew Noble a surprising increase in range can be expected over the 12-mile Jubilee range when this extra allowance of tenuity is taken into account, and a range of 60 miles be almost attainable.

SOME TUNGSTEN ORES IN THE NATIONAL MUSEUM

For some years the department of geology in the United States National Museum has been making a special effort to build up its collections of the so-called rare earths and rare metals, many of which have assumed exceptional importance since the outbreak of the war. These collections include a considerable range of substances which have proved of commercial value only within the past decade, one of the most important of which is the metal tungsten, invaluable in steel manufacture. During the past year the department has received, principally through the intervention of Mr. F. L. Hess, of the U. S. Geological Survey, three most remarkable specimens illustrating the three types of ore of this metal. In its own way, each of the three is unique and undoubtedly the largest of its kind ever mined.

The first is a mass of ferberite (iron tungstate) from the No. 7 lease of the Vasco Mining Co., at Tungsten, Boulder County, Colorado, which was presented by the Vasco Mining Co., and Messrs. Stevens and Holland. The specimen is roughly oval in form, 2 feet

6 inches long, 2 feet broad, and 2 feet thick, and weighs nearly a ton. It is an ore characteristic of the Boulder tungsten field—a brecciated pegmatite and granite cemented by quartz and ferberite.

The second is a large specimen of the newly discovered mineral tungstenite (tungsten sulphide), a gift from Wm. Barrett Ridgely, of New York City. Tungstenite is a soft, lead-gray mineral, looking very much like fine-flaked molybdenite and carries some 44 per cent. tungsten. The specimen, which contains an admixture of some galena and quartz and weighs more than 100 pounds, is from the Emma mine at Alta, Utah. This mineral was identified only last December by R. C. Wells and B. S. Butler, of the United States Geological Survey, and almost simultaneously by K. D. Kuhre and Mr. J. J. Beeson, the geologist at the mine.

The third, and in some ways the most remarkable specimen, is a mass of scheelite (calcium tungstate) from the Union Mine of the Atolia Mining Co., Atolia, California. This mine is undoubtedly the richest and largest scheelite mine ever discovered, and the specimen is correspondingly large. It is a section across the main part of the vein and is 4 feet 8 inches long, about 2 feet 6 inches wide, and 2 feet thick. Some granodiorite, the country rock, is inclosed. The specimen weighs 2,600 pounds and carries possibly 30 per cent. WO_3, so that it contains in the neighborhood of 700 pounds of metallic tungsten and is worth, at the present price of ore, nearly $2,000. Great care was needed to remove the specimen from the mine intact, a work which was carried on under the supervision of Charles S. Taylor, one of the discoverers of the mine and now its superintendent.

CHEMISTRY AT YALE UNIVERSITY

IT has been arranged at Yale University to unite the staffs and laboratories of the undergraduate departments of the college and of the Sheffield Scientific School in a single department. On this plan the *Yale Alumni Weekly* comments as follows:

The article which we publish in this number on the coordination of chemistry teaching in the college and Sheffield marks a move in what we have good reason to believe will shortly become a general reorganization at the university on a new and cooperative departmental basis. Until now chemistry at Yale has been divided into two distinct and unrelated parts, with its two separate faculties and student groups, its two separate laboratories and equipments, its two separate financial systems, its two separate heads. It has furnished a striking instance of the historical cleavage between the Sheffield Scientific School and Yale College, with all the attendant lack of cooperation and sympathetic understanding which that cleavage has for so many years resulted in. If any criticism of Yale's educational organization has been unanswerable, for years it has been this continued separation between its two undergraduate schools in the teaching of common subjects. It has split Yale into two—on occasion even hostile—camps. It has hindered scientific progress in both schools. It has broken up at the start any possible unity of educational policy which might have been accomplished.

Until now it has seemed impossible to find a way to end this illogical and harmful cleavage between Sheff and the college in their educational organization. But the war, which is subtly undermining a good many of our ancient prejudices, both individual and institutional, has begun to play its deciding part in this historic Yale question. The hours of classroom exercises have recently been made to conform for the undergraduates of both Sheff and the college. The departments of chemistry have now found it necessary to reorganize to meet the new conditions, and, in reorganizing, have found it possible and even desirable to cut the old Gordian knot of departmental prejudices and consolidate as a university department. When this new plan goes into effect, Yale will have made its first definite move in what we believe will be a much more general trend in the near future, toward operating its educational machinery as one university organization rather than as two separated undergraduate departments.

In an article on the subject in the *Yale Alumni Weekly* Professors Bertram M. Boltwood and Treat B. Johnson mention as the greatest needs of the university in chemistry: (1) an adequate endowment for research, (2) the appointment of research professors in each department to organize and direct, (3) opportunities to give greater encouragement to our younger men to carry out research work, (4)

conditions tending to stimulate cooperation between manufacturing interests and our research laboratories in order to broaden as much as possible the applied features of our research work.

SCIENTIFIC NOTES AND NEWS

Director William Wallace Campbell, of the Lick Observatory, University of California, has been elected a foreign member of the Royal Society.

The annual gold medal of the British Institution of Naval Architects has been awarded to Professor G. W. Hovgaard, of the Massachusetts Institute of Technology, for his paper on "The Buoyancy and Stability of Submarines."

At the annual meeting of the Chemical Society, London, on March 21, the Longstaff medal for 1918 was presented to Lt.-Col. A. W. Crossley, for his work in the field of hydroaromatic compounds.

The University of Chicago has granted leave of absence to Professor Forest R. Moulton, of the department of astronomy and astrophysics, for one year, from April 1, 1918. He is commissioned major in the Ordnance Reserve Corps of the United States Army, and will have the duty of directing the computation of range tables and ballistic data.

Dr. T. Wingate Todd, F.R.S.C. professor of anatomy in the school of medicine of Western Reserve University, has been granted leave of absence from the university and commissioned captain in the Canadian Army Medical Corps. He is at present stationed at the Military Hospital of London, London, Ontario, and expects to see service in France within a few months.

Dr. Robert W. Hegner, of the University of Michigan, who has been carrying on research work at the Johns Hopkins University during the past year as Johnston scholar, has been reappointed and will continue his investigations there for another year.

T. B. Wood, professor of agriculture in the University of Cambridge, has been appointed to the Development Commission of Great Britain, vice A. D. Hall, now secretary of the Board of Agriculture and Fisheries.

Dr. Elbert C. Lathrop has resigned his position as biochemist in the Laboratory of Soil Fertility Investigations, U. S. Department of Agriculture, to accept a research position with the Jackson Laboratory of the E. I. du Pont de Nemours Company, of Wilmington, Delaware.

Mr. R. C. Bergen, assistant editor of *Metallurgical and Chemical Engineering*, has resigned his position to go into manufacturing work. He has been with the journal since its change to a semi-monthly in 1915.

John C. Schelleng has resigned his instructorship in the department of physics of Cornell University to accept a position in war work with the Westinghouse Electric Company.

The course of lectures on "Symbolic logic" by Mrs. Christine Ladd-Franklin which was to have been given at Harvard University beginning on April 22, has been given up on account of the existing situation. These lectures were given earlier in the season at Columbia University before the Institute of Arts and Sciences.

Professor W. A. Cogshall, of Indiana University, delivered recently an address before the St. Louis Academy of Science on "The problems of the total solar eclipse with particular reference to the Corona and the intra-mercurial planets."

Professor E. V. McCollum, of the school of hygiene and public health of the Johns Hopkins University, delivered a lecture on nutrition, before the faculty and students of the college of medicine, University of Illinois, on April 11.

Dr. E. Emmet Reid, of Johns Hopkins University, delivered an illustrated lecture on "Gas warfare" before the West Virginia Scientific Society on April 15. In the afternoon of the same day, he addressed the students of chemistry of the university on "The present status of the chemist."

Dr. Winfred Berdell Mack, professor of veterinary science and bacteriology in the University of Nevada, died in Reno on January 18, after an illness of three months, aged forty-seven years.

EDWIN SCOTT LINTON, a member of the class of 1918, Johns Hopkins Medical School, and enlisted with the Johns Hopkins Hospital Unit, Base Hospital No. 18, A. E. F., died in France, of scarlet fever, on November 14, 1917. He was the son of Professor Edwin Linton, of Washington and Jefferson College.

DR. S. M. SANDWITH, of the London School of Tropical Medicine, died on February 16, at the age of sixty-four years.

PROFESSOR P. BLASERNA, vice-president of the Senate, and professor of experimental physics in the University of Rome, died on February 26, at eighty-two years of age.

THE agricultural appropriation bill, carrying a total of $28,000,000, has been passed by the Senate.

THE Bureau of Standards has purchased eight acres of land west of Connecticut Avenue, Washington, D. C., and has let contracts for a new engineering laboratory, 175 by 350 feet, and four stories in height. The new building and its equipment will cost in the neighborhood of $1,000,000 and will increase the capacity of the bureau by 50 per cent. The Pittsburgh laboratory of the bureau, including the work on glass and ceramics, will be transferred to Washington. It is expected that the new building will be ready for occupancy during the coming summer.

THE American Electrochemical Society has arranged in connection with its spring meeting in the week of April 28 for a tour through Tennessee and Alabama stopping at the important electrochemical centers and water power developments located in these two states. Among the towns to be visited are Johnson City, Kingsport, Knoxville, Sheffield, Muscle Shoals, Chattanooga, Anniston and Birmingham. A special train will be provided, and about one hundred members and guests have already signified their intention to participate. All those interested can obtain further details from Mr. Charles F. Roth, chairman of the committee, 50 East 41st St., New York City, N. Y.

THE annual meeting of the New England Federation of Natural History Societies will be held on Friday and Saturday, April 26 and 27, at the Rogers Building, Boston, next house to the Society of Natural History. The usual exhibition will be open to members and visitors both days, and all the societies and individual members are invited to exhibit. Packages may be sent by express or left at the building in care of the janitor. Friday evening from 7 to 10 there will be an informal meeting for showing exhibits and for short reports and addresses. Members who can not attend on Saturday are specially invited to this meeting. Saturday, at 10 A.M. the annual meeting will be held for reports from the various societies and for the election of officers and other business. A short account of the last year's work of each society is desired at this meeting. A meeting of the council will be held immediately after the general session to examine the accounts, to decide on the admission of new members and to arrange for future meetings. Saturday afternoon the Boston Mycological Club will have its collections open to visitors from 1 to 5 at its room in the Horticultural Society's Building, 300 Massachusetts Avenue, corner of Huntington Avenue. The Brookline Bird Club will lead an observation walk in the Brookline Parkway, starting from the corner of Brookline Avenue and Audubon Road at 3 P.M.

THE corporation of Yale University has voted to give annually the income from ten thousand dollars to the *American Journal of Science* to assist in the publication of this journal, which this year celebrates its one hundredth anniversary, and to which Professor Edward S. Dana has given so generously of his time and energy for many years.

THE *Bollettino di Bibliografia e Storia delle Scienze Matematiche*, edited by Professor Gino Loria, of Genoa, which has been of such value to mathematicians interested in the bibliography and history of their subject, is about to begin a new series. It will appear in improved form from the press of the well-known scientific publisher, D. Capozzi, of Palermo.

THE *Journal* of the American Medical Asso-

ciation reports that some statistics have recently been published showing that of the 345 medical and other scientific journals published in France before the war, about 270 have suspended publication. Others have changed from weekly to a monthly issue and others issue only four numbers a year. The total quantity of the paper used by them now does not amount to more than 35 tons a month. The important discoveries and experiences of the war and the lessons from them have been spread broadcast by the medical journals, so that surgeons and physicians have been able to keep abreast of progress and thousands of lives have been saved. The organization medical press in France is pleading with the authorities for special concessions during the period of the prevailing scarcity of paper, but no heed has been paid to the appeal as yet.

UNIVERSITY AND EDUCATIONAL NEWS

Yale University has received from the Kingsley Trust Association (Scroll and Key Society of Yale College) $30,000 to commemorate the seventy-fifth anniversary last year of the founding of the society. This is to be added to the endowment of the Kingsley Trust Association Publication Fund, established by the members of the Society in 1914, and will increase the total of this to $50,000; making it the largest publication fund held by the university. The income of the original $20,-000 is used for publications through the Yale University Press in the field of history.

The Massachusetts State College is requesting a state appropriation of $100,000 for the development of women's work at the institution, $70,000 being for a women's building and $30,000 for maintenance until November 30, 1920.

In response to a request from the gun production of the Ordnance Department, United States army, the school of applied science of New York University has put its testing laboratory at the service of the government.

Thomas P. Cooper, director of station and extension work in North Dakota, has been appointed dean of the Kentucky College of Agriculture and director of the Experiment Station.

Dr. H. G. Knight, dean of the college of agriculture and director of the experiment station of the University of Wyoming, has accepted the corresponding position at the Oklahoma College and Station, effective February 1, and has been succeeded at Wyoming by A. D. Faville.

Professor Harvey Evert Huber, professor of biology and geology at Ohio Northern University since 1913, has resigned to accept the professorship of biology at Bluffton College. He will assume his new position in September.

L. T. Anderegg, in charge of the department of chemistry in the high school at Decatur, Ill., has accepted the position at the Kansas State Agricultural College in chemical analysis which was left vacant by the resignation of R. C. Wiley.

Dr. Gerald L. Wendt has been appointed assistant professor of chemistry and curator of the Kent chemical laboratory at the University of Chicago. He has charge of the instruction in quantitative analysis and in radioactivity.

Lina Stern, privatdozent in the University of Geneva, has been appointed professor extraordinary of physiological chemistry.

DISCUSSION AND CORRESPONDENCE

SPECTROSCOPIC INVESTIGATION

To the Editor of Science: An exceptional opportunity for spectroscopic investigation now exists in this country and it seems desirable that it should have the wide publicity of the columns of Science. The Mining Experiment Station at Golden, Colorado, under the Federal Bureau of Mines, specializes in the radium products and the rare gases which are associated with their production. It is likely that larger quantities of the radium emanation, for instance, are available there for research than anywhere else in the world at the present time.

A visit to this interesting laboratory last autumn disclosed the presence there of a large

Hilger spectrograph of the autocolimating type, with very large prisms, and apparently capable of yielding excellent spectra on a large scale. The members of the regular staff of chemists at the Station, under the direction of Dr. R. B. Moore, are too much occupied with their regular duties to undertake special spectroscopic researches. Therefore this fine instrument has not been utilized as it might be. An unusual chance is thus presented for the establishment of a fellowship for spectroscopic research, under the joint auspices of the station and of some university, physical laboratory or scientific fund.

A second consideration of immediate importance lies in the fact that Golden is situated near the central line of the total eclipse of June 8. American science could be accused of grievous neglect, if this spectrograph, already in the eclipse track, should not be used on that occasion by an expert spectroscopist. To many such I have written personally during recent months, urging that the opportunity be improved; but as a result of war duties or the shortage of assistants in the laboratories, thus far no one has been found who could undertake the work.

It would be necessary for the person to go to Golden early enough in May, so that the spectrograph could be put into excellent adjustment and then to mount it where a clear view of the northwestern sky could be had. The necessary heliostat could doubtless be borrowed from some laboratory. The altitude of Golden is 5,700 feet, and if the foliage around the station building was too heavy in June, it would not be at all difficult to transport the spectrograph up to an elevation of about 7,500 feet on Lookout Mountain, where Colonel Cody was buried.

The ideal arrangement will of course be for this same person who gets familiar with this spectrograph to continue in research with it after the eclipse. If a suitable person is found, an effort can be made to raise the necessary funds for a fellowship or other basis which may be arranged for the work.

Time might perhaps be saved for those who may wish to consider the observation of the eclipse with this instrument, if they will write to me directly.

I am writing this at the request of Dr. Charles L. Parsons, of the Bureau of Mines, and Dr. Moore. EDWIN B. FROST

YERKES OBSERVATORY,
WILLIAMS BAY, WISCONSIN,
April 13, 1918

THE DESICCATION OF THE EARTH

TO THE EDITOR OF SCIENCE: In Notes on Meteorology and Climatology in the issue of SCIENCE for October 21, 1910, attention is invited to an article in *Umschau* by Dr. Karl Stoeckel which helps to explain the slow desiccation of the earth.

> It is believed that the ultra-violet rays of sunlight which fall upon the water vapor suspended in the lower strata of the earth's atmosphere decompose a small part of it to produce hydrogen, which rises to great heights. . . .

I do not think it has been pointed out before that the earth's surface must be continuously losing hydrogen through the decomposition of water vapor by every flash of lightning. Pickering and others have recognized the hydrogen lines in the spectrum of lightning, and the larger works on meteorology mention the fact that lightning flashes decompose some water. See Hann's "Lehrbuch der Meteorologie," 2d edition, page 480:

> But the electric flash also decomposes some water and causes the incandescence of the hydrogen.

The hydrogen formed by every lightning flash rises rapidly to the upper atmosphere and is lost to the earth.

Considering the frequency of thunderstorms during the summer season in both hemispheres and at all times in the equatorial regions the loss of hydrogen in this way can not be considered as insignificant. As long as conditions upon the earth remain such as to render thunderstorms possible, the slow desiccation of the earth must continue.

C. F. VON HERRMANN

AREAS OF AUDIBILITY

TO THE EDITOR OF SCIENCE: Students of the constitution of the atmosphere have published

very interesting results as a consequence of the investigation of areas of audibility and *inaudibility* surrounding great sources of sound, such as the blasting for the Jungfraubahn, the bombardment of Antwerp, a munition explosion in England, etc. It seems natural that the Halifax explosion, violent enough to break glass many miles distant and to be heard scores of miles away at sea, should be investigated the same way; but I have read and heard nothing of any such study. It is, of course, a matter for the scientists of the neighboring region, and perhaps they have taken it up.

WILLARD J. FISHER

PRIMITIVE KNOWLEDGE OF INOCULATION

In an article on "The Origin of the Custom of Tea Drinking in China," SCIENCE, March 15, R. A. Gortner remarks that "it is extremely improbable that it was recognized centuries ago that typhoid fevers, etc., were disseminated by pollution of the water supply, especially inasmuch as there was no knowledge of microorganisms or of the rôle which they play in disease until the work of Pasteur (1857–1863)." In adopting this conclusion as *a priori* valid it seems to me that Gortner is in danger of making the same error that was made by Sir Richard Burton in 1854. Burton states ("First Footsteps in East Africa") that "The mosquito bites bring on, according to the same authority (the Somal), deadly fevers; the superstition probably arises from the fact that mosquitoes and fevers become formidable about the same time." This is not the only case, we may be sure, in which causal relations have been recognized long before the causal mechanism was known.

KNIGHT DUNLAP

SCIENTIFIC BOOKS

The Anthocyanin Pigments of Plants. By MURIEL WHELDALE. Cambridge University Press. 1916. Royal 8vo. Pp. xii + 318. Price 15s net.

The science of chemistry has grown so rapidly during recent years that it is impossible for an individual to acquire a thorough knowledge of all of its branches, and even to master a single phase of the science often means laborious searchings through the chemical literature. Fortunately there have appeared during the last decade a number of monographs, each written by an authority in that particular field, which deal thoroughly with a special topic and sum up all of the available literature. Such a compilation is the present volume.

What causes the production of the colors in a flower? Every one has asked himself the question and numerous chemists have attacked the problem, yet it is only within recent years that any definite knowledge has been attained and we still have a long way to progress before we know the whole truth. It is fortunate, however, that Miss Wheldale has accumulated such evidence as is at present available.

Her studies of anthocyanin began with a study of the genetical behavior of these pigments, but she soon ascertained that biological phenomena have for their basis chemical reactions, with the result that she undertook to analyze the chemical changes which were involved in the hereditary behavior of flower coloration. The present volume is divided into two parts. Under Part I., "General Account of Anthocyanins," we have "Introductory," consisting mainly of the older literature of the subject; "The Morphological Distribution of Anthocyanins"; "The Histological Distribution of Anthocyanins"; "The Properties and Reactions of Anthocyanins"; "The Isolation and Constitution of Anthocyanins"; "Physiological Conditions and Factors Influencing the Formation of Anthocyanins"; "Reactions Involved in the Formation of Anthocyanins"; and "The Significance of Anthocyanins," practically all of which are taken up from the chemical viewpoint.

Under Part II., "Anthocyanin and Genetics," we find "Classes of Variation"; "Details of Cases of Mendelian Inheritance in Color Varieties"; "Connection of Flower Color with the Presence of Anthocyanin Vegetative Organs, Fruits and Seeds"; "Heterozygous Forms"; "Color Factors in Reduplication

Series"; "Pattern in Color Variation"; "Striped Varieties and Bud Variation"; "The Effect of Outside Factors on Color Variation"; "Connection Between Color and Other Plant Characters"; and "The Chemical Interpretation of Factors for Flower Color;" all discussed from the standpoint of the geneticist. In addition there is appended a bibliography of 645 titles, to the majority of which Miss Wheldale has added a short descriptive notice indicating the nature of the contents of the paper.

To any one who has followed Miss Wheldale's researches it is needless to add that the work is thoroughly done. Apparently as much space has been given to the papers of her critics as to her own work, so that the reader can draw his own conclusions as to the facts involved. If there is any one fault to find with the work it would seem to the writer to be that the author has not drawn upon her imagination sufficiently to formulate theories which would appear to be warranted by the facts which she presents. This is not a common fault in works of this nature where chemical and biological phenomena are involved and perhaps the author is correct in being extremely conservative. At any rate she can not be accused of attempting, by publishing this monograph, to further any pet hypothesis.

ROSS AIKEN GORTNER

UNIVERSITY OF MINNESOTA

DR. KEEN ON MEDICAL RESEARCH

DR. W. W. KEEN, the Nestor of the American medical profession, has given us a delightful little book on "Medical Research and Human Welfare," being the Colver Lectures of Brown University for 1917.

Dr. Keen is peculiarly fitted for his task, as he was trained in the old septic era of surgery before the civil war, and was a part and parcel of the war with all its attendant horrors, its infections and gangrenous wounds with maggots, and its enormous percentage mortality, and yet has lived not only to witness but to promote the new era of antiseptics and to enjoy the phenomenal changes thus wrought in his own work and that of his colleagues.

This interesting little book has a twofold value, it will attract the lay public asking for a conspectus of the progress of the last forty years in charming readable non-technical terms; it will also interest doctors, who will enjoy a brief historic retrospect of professional achievements told in just such simple terms as they themselves are apt to use over a fireside conversation when the older men are prone to indulge in reminiscences and comparisons.

A further use is to furnish material for those who wish to forestall interference on the part of the anti-research people (who call themselves "antivivisectionists"), with medical progress.

The medical profession in our day has stepped forward into an era of medical statesmanship, and now needs constantly to appeal to the public for moral support and cooperation in many matters of vital interest to the whole body politic. It would be well for this reason if this book were widely read and the facts kept well in mind and often used in arousing the sympathy of the public in one of the greatest of all causes—medical progress, the saving of life and health.

HOWARD A. KELLY

THE ANNUAL MEETING OF THE NATIONAL ACADEMY OF SCIENCES

THE program of the scientific sessions of the meeting held in Washington beginning on April 22 was as follows:

MONDAY, APRIL 22

Morning Session

The effects of a prolonged reduced diet on twenty-five college men:

I. On basal metabolism and nitrogen excretion, by Francis G. Benedict.

II. On neuromuscular processes and mental condition (illustrated), by Walter R. Miles (introduced by F. G. Benedict).

III. On efficiency during muscular work and general muscular condition (motion pictures), by H. Monmouth Smith (introduced by F. G. Benedict).

The partial occlusion of great arteries in man and animals (illustrated), by W. S. Halsted.

Three papers (illustrated):

(a) The favorable effect of subcutaneous injec-

tion of magnesium sulphate in tetanus; (*b*) the possible danger of intravenous injection of magnesium sulphate; (*c*) The antagonistic and curative action of calcium salts in these cases, by S. J. Meltzer.

The Liberty field hospital ward. Designed on the unit construction plan. Portable. Adapted to American overseas summer and winter service (motion pictures), by Henry Fairfield Osborn.

The war and medical research (illustrated), by Simon Flexner.

Afternoon Session

Conformal geometry, by Edward Kasner.

Magnestism by rotation (illustrated), by S. J. Barnett (by invitation. Comstock prize recipient).

On the correction of optical surfaces, by A. A. Michelson.

Some recent observations of the brighter nebulæ (illustrated), by W. W. Campbell.

Physical researches for the war, by R. A. Millikan.

Evening Session

First William Ellery Hale Lecture, by John C. Merriam, professor of paleontology, University of California. Subject: The beginnings of human history from the geologic record. (Open to the public.)

TUESDAY, APRIL 23

Morning Session

Notes on isotopic lead, by F. W. Clarke.

The physico-chemical properties of gluten, by Lawrence J. Henderson (introduced by Raymond Pearl).

Correlation of the tertiary formations of the southeastern United States, Central America and the West Indies, by Thomas Wayland Vaughan (introduced by David White).

Coast survey charts and fringing reefs of the Philippine Islands (illustrated), by W. M. Davis.

Recent researches on the skeletal adaptations and modes of locomotion of the Sauropod Dinosaurs (illustrated), by Henry Fairfield Osborn and William K. Gregory.

Some additional data on the Cambrian Trilobites (illustrated), by Charles D. Walcott.

The development of governmental regulations during the world war, by C. R. Van Hise.

Afternoon Session

The big bears of North America, by C. Hart Merriam.

The growth of the Pribilof fur-seal herd between 1912 and 1917 (illustrated), by G. H. Parker.

A comparison of the growth changes in the nervous system of the rat with the corresponding changes in man (illustrated), by Henry H. Donaldson.

Measuring the mental strength of an army (illustrated), by Robert M. Yerkes (by invitation).

Second William Ellery Hale Lecture, by John C. Merriam, professor of paleontology, University of California. Subject: The beginnings of human history from the geologic record.

SPECIAL ARTICLES

A SIMPLE METHOD OF MEASURING PHOTOSYNTHESIS[1]

In collaboration with Loeb[2] one of us observed that certain marine algæ when exposed to sunlight cause the sea water to become more alkaline. Similar observations had been previously made by others[3] upon fresh-water plants in solutions containing bicarbonates.

It seemed to the writers that this procedure might be utilized in the study of photosynthesis. After investigating a number of marine plants it was found that *Ulva* (sea lettuce) is very satisfactory for such experiments. A piece of *Ulva* was placed in a beaker and covered with sea water to which a little phenolphthalein[4] had been added. It was then placed in direct sunlight. In the course of an hour the solution turned pink. The pink color grew steadily more pronounced and at the end of another hour was intense.

It seemed evident that by measuring the alkalinity which produced the change of color we might arrive at a simple and satisfactory method of studying photosynthesis.

In order to measure the degree of alkalinity produced by *Ulva*, a piece of the frond was placed in a tube of Pyrex glass[5] (about 12 mm. in diameter) in such a manner that it com-

[1] Preliminary communication.

[2] Loeb, J., "Dynamics of Living Matter," 1906, p. 98.

[3] *Cf.* Czapek, F., "Biochemie der Pflanzen," 1913, 1: 519.

[4] Ten drops of saturated alcoholic phenolphthalein was added to 1 liter of sea water. For class demonstration more may be added.

[5] This glass was chosen because it does not give off measurable quantities of alkali during the period of the experiment.

pletely covered the inside of the tube for the greater portion of its length. Fronds were chosen which were sufficiently stiff so that their own elasticity caused them to remain closely and evenly pressed against the inner surface of the glass tube even when liquid was poured in and out or shaken back and fourth in the tube.

The glass tube was sealed off at one end, while at the other it was furnished with a short piece of rubber covered with paraffin.[6] The covering of paraffin was continuous and care was taken to renew it each time the tube was used.

After placing the frond in the tube, the latter was filled with sea water (at the temperature of the bath) and the rubber tube was clamped shut. In some cases a small bubble of air was left in the tube to act as a stirrer: in other cases the tube was completely filled with sea water and the stirring was effected by a small piece of paraffin or by a glass bead covered with paraffin.

The tube was then placed in a large water bath in direct sunlight. The tube was slanted so as to receive the sunlight nearly at right angles. The light passed through a sufficient amount of water to filter out most of the heat rays. Some light was reflected from the surface of the water but this was practically constant during any one experiment. The temperature of the bath was kept constant within 1° in most of the experiments.

In order to determine the degree of alkalinity produced by photosynthesis two methods were used. In the first the indicator was added to the sea water containing *Ulva* after a definite exposure to sunlight; in the second the indicator was added to the sea water before the exposure began. In the latter case there was a possibility that the presence of the indicator might affect the amount of photosynthesis, but it was found by control experiments that this was not the case with the concentrations employed in these experiments.

It was also necessary to ascertain whether the degree of alkalinity produced was a reliable measure of the amount of photosynthesis. This was done by making simultaneous determinations of the degree of alkalinity and the amount of oxygen evolved (by Winkler's method). The results show that the amount of photosynthesis, as indicated by the evolution of oxygen, is approximately a linear function (in this range) of the change in the PH value of the sea water. This being so we can measure the amount of photosynthesis by determining the change in PH value regardless of any possible complications such excretion of alkali by the plant.

Since the plants produce CO_2 by respiration this must be taken into consideration. Experiments conducted under precisely the same conditions except that light was excluded showed that the respiration was practically constant. It is, therefore, easy to make a correction for it.

In order to ascertain how much photosynthesis had taken place after a definite time the pink color produced by the *Ulva* was matched against the colors of a series of tubes (of the same size) containing the same concentration of indicator in a series of buffer solutions of known alkalinity.[7] The matching was done under a "Daylight" lamp, which is invaluable for this purpose.

In this way the degree of alkalinity produced may be easily ascertained and since this corresponds to the amount of oxygen evolved it gives us a direct measure of photosynthesis, provided we know the amount of CO_2 or of O_2 corresponding to the observed changes in alkalinity. These may be determined in various ways which can not be discussed here.

[6] It is necessary to use paraffin which will not give off measurable quantities of acid during the time of the experiment. For this purpose paraffin of a high melting point is usually advantageous. Rubber should be used which gives off the minimum amount of acid; the rubber used in these experiments was repeatedly boiled before using.

[7] For buffer solutions see: Sörensen, *Biochem. Zeit.*, 21: 131, 1909; *Ergeb. d. Physiol.*, 12: 392, 1912. Höber, R., *Physik. Chem. d. Zelle u. d. Gewebe*, 4te Aufl., 1914, S. 169. Bayliss, W. M., "Principles of General Physiology," 1915, p. 203.

For the PH values needed in these investigations mixtures of .05 *M* borax and 0.2 *M* boric acid (to each liter of boric acid 2.925 gm. NaCl is added) are useful. The following table gives the

In order to study the effects of temperature, light intensity, etc., it is not necessary to know the amount of CO_2 abstracted; it is sufficient to compare the time required to produce the same change in the color of the indicator under different conditions. This gives much more accurate results than comparison of the amounts of CO_2 abstracted in equal times. In case anything is added to the solution which changes its buffer value due allowance must be made for this.

It is evident that the method is accurate, simple, rapid and convenient, permitting us to measure minute amounts of photosynthesis at frequent intervals.

It may be added that aquatic plants are greatly to be preferred to land plants for quantitative studies of photosynthesis because in the latter the temperature can not be satisfactorily controlled while with the former the fluctuations can be confined within one degree, or less.

Similar experiments were made with a variety of fresh-water plants, including *Spirogyra, Hydrodictyon* and *Potamogeton.* The results were very satisfactory. The usual procedure was as follows: A gallon bottle was filled with the water in which the plants were growing, a little phenolphthalein was added and a solution of sodium bicarbonate was then added, drop by drop, until a pink color was produced.[8] On pouring this into the tubes used in the experiments the pink color was not perceptible since the layer of liquid was not sufficiently thick.

When the algæ were placed in these tubes in sunlight a pink color appeared in a short time. If the tubes were placed in the dark the color disappeared as the result of respiration. In many cases the algæ lived for several days in these tubes and made considerable growth, showing that they were not injured.

The method is well adapted to class work. For ordinary laboratory demonstrations Pyrex glass is not necessary since any good glass[9] will answer. It will be found that some algæ (particularly blue-green and unicellular green algæ) will operate satisfactorily in diffused daylight. It is important, however, that the plants be in active condition. Aquatics are apt to prove unsatisfactory in fall and winter while in spring and summer the same species may be very active.

SUMMARY

Minute amounts of photosynthesis can be accurately measured by placing aquatic plants in solutions containing bicarbonates, with a little phenolphthalein, and observing changes in the color of the indicator.

The convenience, simplicity and rapidity of the method make it as useful for class-room demonstration as for quantitative investigations.

W. J. V. OSTERHOUT,
A. R. C. HAAS
LABORATORY OF PLANT PHYSIOLOGY,
HARVARD UNIVERSITY

PH values of a series of mixtures (Palitzsch, S., *Bioch. Zeit.*, 70: 333, 1915. *Compt. rend. lab. Carlsberg,* 11: 199, 1916). *Cf.* McClendon, J. F., Gault, C. C., Mulholland, S., Pub. 251 Carnegie Inst., 1917, pp. 21-69.

0.2 *M* Boric Acid, c.c.	.05 *M* Borax, c.c.	PH
0	10	9.24
1.0	9.0	9.11
2.0	8.0	8.98
3.0	7.0	8.84
4.0	6.0	8.69
4.5	5.5	8.60
5.0	5.0	8.51
5.5	4.5	8.41
6.0	4.0	8.31
6.5	3.5	8.20
7.0	3.0	8.08
7.5	2.5	7.94
7.7	2.3	7.88
8.0	2.0	7.78
8.5	1.5	7.60
9.0	1.0	7.36
9.4	0.6	7.09
9.7	0.3	6.77

By plotting the c.c. of borax as ordinates and the PH values as abscissae a curve is obtained from which intermediate values can be obtained by graphic interpolation.

From the PH values found in sea water 0.21 must be subtracted on account of the "salt error."

[8] This solution should be freshly made each day.

[9] Open bottles, test-tubes, beakers or tumblers may be employed.

SCIENCE

FRIDAY, MAY 3, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A CHEMICAL STUDY OF ENZYME ACTION[1]

IN making up the list of papers to be presented at this meeting to-day, it was stated that the intention was to "get at the fundamental things in enzyme activity." Since the chemical nature of an enzyme is as fundamental for the understanding of an enzyme action as any other factor, I shall present some results obtained during the last six years bearing on this question.[2] It will not be necessary to give a definition of enzymes here or to present a classification of enzyme actions. This has been done repeatedly and it would appear that at present nothing essential can be added in this respect. The question will be taken up as a chemical problem. Certain definite chemical changes may be accelerated under definite conditions; certain products obtained from living organisms have the property of accelerating these changes; these accelerations can be controlled within limits by altering the conditions. The problem in its simplest terms is the study of the chemical nature of these products of animal or plant origin which accelerate the changes. At the same time, influences physical in nature, such as the solvent and the colloidal properties of the materials must not be lost sight of, as they undoubtedly play a part in modifying the velocities of the reactions.

[1] Presented at the meeting on "Enzymes and their Behavior" before the Division of Biological Chemistry, American Chemical Society, Boston, September 12, 1917.

[2] The work was published in a series of papers in *J. Am. Chem. Soc.*, 1912–15, and in *Proc. Nat. Acad. Sci.*, 1, 136 (1915), 2, 557 (1916); *J. Biol. Chem.*, 31, 97 (1917).

Since enzymes manifest their actions by increasing the velocities of chemical reactions, a large amount of work has been done in studying the kinetics of such reactions. The actual results obtained from such studies in so far as light has been thrown on the chemical nature of enzymes has been disappointingly meager. In fact the results which might be expected from such studies have been in large measure unsatisfactory. This may be shown by a brief survey of some of the work on the kinetics of invertase action, to which, from this point of view, more attention has been paid than to any other enzyme action. Invertase, as is well known, hydrolyzes cane sugar to form glucose and levulose. O'Sullivan and Tompson[3] in 1890, as a result of the study of the kinetics of this reaction, concluded that the reaction was of the first order, the velocity being proportional to the concentration of the cane sugar. Duclaux[4] in 1898, Brown[5] and also Henri[6] in 1902, found that the velocity of this reaction was not of the first order as shown by the lack of constancy of the velocity coefficients. Henri[7] suggested in 1905 that because of the colloidal nature of enzymes, the reaction belongs to a two-phase system to which the simple mass law is not applicable in the given manner. Hudson[8] in 1908 as a result of some new work in which the mutarotation of the invert sugar was taken into account, found that the hydrolysis of cane sugar in the presence of invertase gave velocity coefficients that were constant when calculated by the unimolecular formula. He therefore claimed to have confirmed the conclusions of O'Sullivan and Tompson. Michaelis and Menton[9] in 1913 disagreed with Hudson in attempting to express the velocity of the reaction as a simple logarithmic function of the sugar concentration and elaborated the view of Henri of the two-phase system and formation of an intermediate compound. Bayliss[10] in 1911 developed the view of such intermediate compounds as adsorption compounds and concluded that the rate of enzyme action was a function of the amount of adsorption compound in existence at any particular time. Nelson and Griffin[11] in 1916 developed the two-phase system view of invertase action and in 1917, as a result of an extended series of experiments, Nelson and Vosburgh[12] summarized and stated clearly the present status of the problem of the kinetics of invertase action. Their conclusions may be stated briefly as follows:

I. The velocity of inversion is directly proportional to the concentration of the invertase.

II. The velocity is nearly independent of the concentration of the cane sugar in the more concentrated sugar solutions, while in very dilute sugar solutions the velocity increases with increase in concentration of the substrate and finally reaches a maximum.

III. The results obtained agree with the heterogeneous reaction view and contradict the claim that the kinetics of invertase action conform to the unimolecular law for homogeneous reactions.

[3] O'Sullivan and Tompson, *J. Chem. Soc.*, 57, 834 (1890).

[4] Duclaux, *Ann. Inst. Pasteur*, 12, 96 (1898).

[5] Brown, *J. Chem. Soc.*, 81, 375 (1902).

[6] Henri, *Z. Physik. Chem.*, 39, 215 (1902).

[7] Henri, *Z. Physik. Chem.*, 51, 19 (1905).

[8] Hudson, *J. Am. Chem. Soc.*, 30, 1160, 1564 (1908).

[9] Michaelis and Menton, *Biochem. Z.*, 49, 333 (1913).

[10] Bayliss, *Proc. Roy. Soc. London* (*B*), 84, 90 (1911).

[11] Nelson and Griffin, *J. Am. Chem. Soc.*, 38, 1109 (1916).

[12] Nelson and Vosburgh, *J. Am. Chem. Soc.*, 39, 790 (1917).

IV. Adsorption is one of the controlling factors in the kinetics of invertase action, and the velocity of inversion curve has the same general shape as adsorption curves, as suggested by Henri.

This brief review will show the uncertainty of the conclusions from the results obtained in the study of the kinetics of one of the most carefully measured of enzyme actions. The factors controlling the velocity of this reaction are just beginning to be cleared up, the simple earlier views being incomplete.

An unsuccessful attempt to formulate the kinetics of enzyme action in a comparatively simple way may be mentioned. The hydrolysis of urea to form ammonia and carbon dioxide was used by D. D. van Slyke[13] to develop a general theory of the kinetics of such enzyme actions based upon the assumption of an intermediate compound between enzyme and substrate. Unfortunately, in the development of the equations a further assumption was introduced which limits their validity and applicability to definite conditions which are realized only in special cases.[14]

The study of the kinetics of enzyme action has not, therefore, led to any results with regard to the chemical nature of enzymes, even in the simplest cases of chemical changes. Practically all enzymes are colloids, and when the substrate also is a colloid, as in the action of a protease on a protein, it is obvious that the conditions are complicated to such an extent that a quantitative study of the kinetics of such a reaction appears to be almost hopeless, although valuable qualitative results may be obtained.

The study of the chemical nature of enzymes is complicated in most cases by reason of the complexity of the substances whose changes they accelerate. This difficulty can be obviated for a few of the enzymes. For example, the lipases and esterases accelerate the hydrolysis of fats and esters. While the mechanism of the hydrolysis of an ester to form acid and alcohol in the absence of lipase is not known definitely, still the compositions and properties of the initial and final products undergoing the enzymatic change are known. This eliminates, partly at any rate, one of the unknown factors of the enzyme problem, and is the main reason for studying lipase in connection with the question of the chemical nature of the active catalyst, the enzyme.

Practically all enzymes are colloids or are intimately associated with substances having colloidal properties. Furthermore, in a large number of cases, it seems that the enzyme is associated with protein matter, either as an essential part of the protein molecule, or accompanying it in such a way that separation has not yet been effected. Among the enzymes which chemically show the characteristics of proteins may be mentioned the amylase obtained by Sherman,[15] proteases and lipases. On the other hand, the invertase described by Nelson[16] is a carbohydrate phosphoric acid complex containing about one per cent. of nitrogen in the form of protein.

These facts make it evident that for the case of lipase, to use a specific example, the isolation of the enzyme in a pure state is a phase or part of the problem of the isolation of a pure protein, since in the separation of the active lipase from inactive material present with it, the resulting bodies approach more and more nearly in proper-

[13] D. D. Van Slyke and G. E. Cullen, *J. Biol. Chem.*, 19, 146 (1914).

[14] *J. Biol. Chem.*, 28, 389 (1917).

[15] Sherman and coworkers, *J. Am. Chem. Soc.*, 1912–1917.

[16] Nelson and Born, *J. Am. Chem. Soc.*, 36, 393 (1914).

ties and composition those which are generally taken to typify proteins. In the problem of isolating pure proteins, it has been possible by careful treatment to obtain bodies having the same properties at different times. This is somewhat different from obtaining a pure protein possessing the same properties as when present in living matter. The operations involved in such isolations are always sufficient to change the properties of the protein to some extent. The problem of isolating a pure lipase, for example, must wait therefore for the solution of the problem of the isolation of proteins possessing the properties which they exhibit in living matter, using the term living to include also matter showing the actions of enzymes.

If, therefore, there is little hope at present of isolating a pure enzyme, considering also the colloidal nature of the material with which it is necessary to work, there is a possibility of attacking the problem in a somewhat different way. An enzyme, as a rule, accelerates a more or less specific reaction or group of reactions. Considering the very complex nature of the protein or other molecule which includes the enzyme, or with which the enzyme may be associated, and the more or less specific reaction which it accelerates, it would appear as if some definite grouping in the complex enzyme molecule were responsible for a given enzyme action. Although this is an assumption there is considerable ground for making it, considering the views held at present with regard to the probable mechanism of the reaction of ester hydrolysis, and the complex nature of the protein enzyme molecule compared with the comparatively simple ester, acid, alcohol molecules involved in the catalyzed reaction. At any rate, this is the view upon which the work on the chemical nature of enzymes was based; namely, that part of the complex molecular grouping of the protein material is responsible for a given action. The problem therefore resolves itself into a study of the chemical nature of this grouping.

The colloidal properties of the protein and other molecules as a whole also influence the rates of reaction, especially with insoluble fats in the case of lipase, for example. Emulsifying agents also play a part, but it appears from the experimental evidence available that such agents do not cause enzyme action in the absence of a definite enzyme grouping, while, on the other hand, enzyme action occurs even without the emulsifying or other agent, though perhaps not to as great extent as in their presence.

The main factor, therefore, may be taken to be the chemical grouping, the physical and other properties modifying to a greater or less extent the typical action of the active enzyme grouping though not changing its nature.

The point of view has been presented from which the study of the chemical nature of enzymes was developed. As stated before, the experimental work was done for the most part with lipase because of the better known properties of the substrate and its reaction products. The greater part of the lipase work was carried out with preparations from castor beans, although other sources were also used. There has been a general tendency in the study of enzyme actions to attempt to attain conditions under which the enzyme would show a maximum action. This method of studying the problem is likely to introduce a number of new complicating factors, so that it was considered that if the action was due to some definite grouping, a study of the factors which caused a loss of the action

might aid in throwing light on the nature of the grouping. A systematic study of the factors which caused inactivation of the esterase and lipase was therefore undertaken. The results were presented in detail elsewhere.

Inactivation of the lipase and esterase preparations was brought about by acids, bases, neutral salts, alcohols, acetone, esters and heat.

The different ways in which these preparations may be inactivated make it appear at first sight as if different reactions occur in the inactivations. If, however, a definite chemical group is responsible for a definite enzyme action, it might perhaps be more reasonable to assume that inactivation follows a definite reaction. The preparations used were essentially protein in character. There was no evidence that a dehydration, or loss of the elements of water, caused inactivation. Some of the reactions indicated that a possible hydrolysis might be a cause of inactivation. With proteins, hydrolysis is generally taken to occur with the —CO—NH— group, the peptide linking, which goes over into the carboxyl and amino groups. Experiments with all the inactivations in no case showed an increase in the formol titration such as would be expected in this reaction, and, therefore, makes the assumption of such a hydrolysis improbable. Coagulation of the material accompanied some of the inactivations. This physical change alone does not appear satisfactory as an explanation; some change in chemical structure unquestionably must accompany or produce the physical phenomenon. Furthermore, the lipase material in suspension in water showed the same activity as in 1.5 normal sodium chloride solution when tested immediately.

The explanations of the chemical changes accompanying inactivation so far suggested are not satisfactory. The reagents used are simple. It is difficult to conceive of a very deep-seated chemical reaction taking place under so many different conditions, none of a complex nature. The only chemical change which appears probable under these conditions is that involving a simple rearrangement within the molecule, such as a tautomeric change involving the change in position of a hydrogen atom. In considering the structure of proteins it is evident that such a rearrangement is possible in the peptide linking.

The hypothesis to be suggested is that the active grouping of the esterase and lipase preparations is of the enol-lactim structure, —C(OH) = N—, the specificities being dependent in part upon the groups combined with the carbon and nitrogen, and that inactivation consists primarily in a rearrangement to the keto-lactam group, —CO—NH—.

This hypothesis was tested in several different ways. It has been found that in tautomeric substances, the presence of alkali in solution favors the enol form of compounds showing such tautomerism, while acid favors the existence of the keto form. The hydrolytic actions of some simple dipeptides on esters at different hydrogen-ion concentrations would, therefore, be evidence bearing on this point, the alkaline solutions presumably favoring the enol-lactim structure. In order to find the actions exerted by the amino-carboxyl groups of the peptide, the hydrolytic actions of a number of amino acids on different esters were determined at the same hydrogen-ion concentrations. The actions of the dipeptides and amino acids were also measured with the amino-carboxyl groups actions masked by the hydrogen of the carboxyl group being replaced by the ethyl group,

and also by testing compounds such as hippuric acids, which do not contain an amino group.

In these compounds, it is possible that the equilibrium between the keto-lactam enol-lactim forms might be changed rapidly if the conditions were changed slightly. A more stable substance was therefore studied from this point of view. Imido-esters, as shown by the formula (a), possess the enol-lactim structure in which the hydrogen atoms may be substituted by organic radicals. The hydrolytic actions on esters of ethyl imidobenzoate (b) at different hydrogen-ion concentrations and various conditions were measured.

$$\underset{(a)}{R-C(OR')=NR''}, \qquad \underset{(b)}{C_6H_5-C(OC_2H_5)=NH}$$

Finally, in order to reproduce the conditions and properties of naturally occurring lipases as far as possible, a number of different proteins were treated with alkali for the purpose of producing an enol-lactim grouping in the peptide linking if this were possible, then neutralized to different hydrogen-ion concentrations and the hydrolytic actions tested on a number of different esters.

As the data obtained have been presented in detail in the papers referred to, they will not be repeated here. It may be stated that the assumption with regard to the active grouping has been borne out by the experimental facts with the different series of compounds. Especially interesting are the ester hydrolyzing substances obtained by the action of alkali on a number of proteins.[17]

It must be emphasized that no direct conclusive evidence is presented as to the actual chemical configuration of the active lipase grouping. The steps in the reasoning may be summarized as follows:

Inactivation (and therefore also activation) is assumed to be due to a tautomeric rearrangement whose possible nature is indicated. Simple substances possessing such structures show the actions and some other properties of naturally occurring lipases present in protein materials. Inactive proteins treated in such a way as to produce the supposedly active grouping show ester-hydrolyzing properties.

Whether it is possible to go much beyond this in the present state of the knowledge of the chemical nature of proteins and the changes they undergo with simple treatment, is an open question. However, one possible line of development bearing directly upon the present problem may be indicated.

The equilibrium in solution between the tautomeric forms of acetoacetic ester, and also of other substances, depends to a great extent upon the solvent.[18] This suggests that with the enol-lactim keto-lactam tautomerism in proteins, the colloidal properties of the protein material may well exert an influence on the grouping comparable to the effects of the solvent on the tautomerism of acetoacetic ester just mentioned. The decreased stabilities or increased rates of inactivation of enzyme preparations when separated to a greater or less extent from colloidal and other matter not connected with the actions may then parallel the actions of the solvents on the equilibria between the tautomeric forms of acetoacetic ester.

In the development of the hypothesis regarding the active grouping in lipase actions, the experimental work and discussion was limited almost entirely to the pep-

[17] F. H. Frankel, *J. Biol. Chem.*, December (1917).

[18] K. H. Meyer and F. G. Willson, *Ber.*, 47, 832 (1914).

tide linking. It is evident, however, that such tautomeric structures, enol-lactim and keto-lactam, may be present in other groupings, and the results of this investigation in no way limit the lipolytic activity to the peptide linking. In view of the complexity of the protein molecule, it is highly probable that such tautomeric groupings are present in combination with other groups and that the specificities of the actions are in part dependent upon these.

It must be admitted that the treatment of proteins with alkali to form active substances is rather drastic. Unquestionably, simpler methods, comparable to those taking place in nature, will be found to produce the same effects. The fact that dilute alkalis inactivated the castor bean globulin lipase, while a certain higher concentration of alkali produced an ester-hydrolyzing substance from the inactive globulin preparation, indicates that differently placed groups in the molecule were involved in these two changes.

In how far the conclusions reached with lipase may be applied to other enzymes is a question. It seems probable, because of the comparatively simple treatments by which most enzymes may be inactivated, that with them also a simple rearrangement or perhaps tautomeric change is connected with loss in activity. There is, however, no reason to suppose that the active grouping is the same for all enzymes. Each enzyme must be studied separately and conclusions as to the chemical nature of one active enzyme grouping can not without further evidence be applied to an enzyme grouping connected with a different action. The work described with lipase has given a definite point of view, if nothing further, from which the study of this enzyme may be continued, and it seems probable that similar systematic studies with other enzymes would yield interesting and valuable results.

K. George Falk

Harriman Research Laboratory,
Roosevelt Hospital, New York

THE CONSERVATION OF WHEAT

The U. S. Food Administrator has done, and is doing, a splendid work in the conservation of wheat, notwithstanding the many obstacles which he has had to overcome. He has met, with wonderful ability and success, one of the most difficult situations of the ages. At times he has been harassed by self-appointed experts and advisers who have often hindered when they should have helped in the conservation of food, particularly of wheat. This is a time to put aside hobbies and pet theories and look the facts squarely in the face.

One of the suggestions frequently offered to make the wheat crop go farther is to mill it so as to include with the flour a portion, or all, of the wheat by-product, and then to require universal use of such a flour. The present ruling of our Food Administrator, permitting the manufacture of whole-wheat flour and also of flour that contains approximately 75 per cent. of the wheat kernel, rests upon a sound, economic basis. The usual argument of the whole-wheat flour advocates is that the product is more nutritious, and that the wheat can be made to go farther when it is milled so as to include a part or all of the by-product.

The March 8 (1918) issue of Science contains an article: "Shall We Eat Whole Wheat Bread?" by L. A. Dutcher, in which reference is made to my work on the nutritive value of breads. This article follows the usual trend of the whole-wheat bread advocate. I would make no mention of the article if it were not for the fact that I believe attention should be called to certain omissions, a misquotation and a selective and unusual use of data from my publications that might lead to erroneous conclusions, particularly as one of the bulletins quoted, Minn. No. 54, is no longer in print, or available for distribution.

Dutcher says:

Using Professor Snyder's own digestion coefficients, we find the energy available in patent, whole wheat and graham breads was 90.9, 89.8 and 85.1 respectively.

The reference figure refers to Bulletin 126, U. S. Department of Agriculture, O. E. S. While upwards of thirty individual digestion trials are reported in this bulletin arranged in groups of three tests for each flour, the above figures which Mr. Dutcher uses are not the averages of all the tests on each flour, but he has selected the group of figures which gives the highest energy values for the whole-wheat and graham flours and the lowest for the white. This fact will be observed from the following table compiled from the bulletin mentioned.

AVAILABILITY OF ENERGY OF BREADS
Bul. 126, U. S. Dept. Agr., O.E.S.

	White	Whole Wheat	Graham
From page 29, average of 3	90.9	89.8	85.1
From page 29, average of 3 (1899–1900)	90.1	85.5	80.7
From page 29, average of 6	90.5	87.6	82.9
" " 45, " " 3	90.4	84.2	82.6
" " 45, " " 3	94.2	88	

Dutcher uses the first line of figures (90.9, 89.8, 85.1).

In my work which he assails I have used the average of all results recorded in this and other bulletins of this series. Dutcher could have selected tests where the difference between the two flours was eight per cent. and more instead of about one per cent., had he so desired. (See Bull. 156, U. S. Dept. Agr., O. E. S. p. 56) It can not consistently be argued that this selective use of data does not affect the final conclusion which he draws:

We can rest assured that the difference in digestibility of the two flours is not great.

No data are presented upon which to rest such an assurance.

He attempts to show that my early tests, in 1897, on the digestibility of whole-wheat bread are different from my later tests. He says, quoting from Bulletin No. 54, Minn. Experiment Station:

Omitting details of the separate experiments it was found that there was practically no difference in the total digestibility of breads made from the three kinds of flour (patent, bakers' and whole-wheat flours). This sentence is selected from the article "The Digestibility and Composition of Bread" as noted on the title page of bulletin No. 54.

The quotation is inaccurate. Mr. Dutcher adds the part put in parenthesis, but omits the final conclusion reached that says: (p. 44).

As to the superior merit of whole-wheat flour over ordinary flour, it is more a question as to the quality of the wheat from which each flour has been made.

Omission is also made of the fact that in this test the whole-wheat flour was not milled from the same wheat as the white flour. It was purchased in the open market and "had evidently been made from winter wheat." p. 44. Had Dutcher followed the footnote on page 43 he would have found the patent flour was made from spring wheat, (See Bulletin 67, U. S. Dept. Agr., O. E. S. p. 34.)

It may be argued that his additions to the sentence simply tend to make my meaning clear, and that what he adds is correct. That is not the case. The sentence he quotes begins with: "Omitting details." He has added details. Any additions should have been complete and should have given the reader all the information necessary to understand the sentence when separated from the article. The sentence without Dutcher's additions, and separate from the rest of the text has no special meaning. Dutcher could have quoted a sentence that would have given all the facts, and which would have been complete when separated from the text, namely, the sentence given above summarizing the entire experiment, that the merit of one flour over the other "is more a question as to the quality of the wheat from which each flour has been made." Dutcher's additions to the sentence "(patent bakers' and whole-wheat flours)," without the necessary qualifications, mean products entirely different in character from those of the same name, in all other tests. It is like two

John Smiths, same name, but different persons and with distinguishing characteristics, which he has omitted.

This initial test in 1897 showed the necessity of having the whole-wheat and white flours milled from the same wheat, which was done and so reported in all subsequent work. The necessity of having all flours compared, milled from the same wheat is specifically mentioned in Director True's letter of transmittal[1] to the Secretary of Agriculture. He says:

A special point in connection with Professor Snyder's report is that the different samples of flour used were all ground from the same lot of wheat. His investigations form an unusually satisfactory basis for judging the comparative nutritive value of so-called "graham" flour, which contains the whole-wheat grain and which is really an unbolted wheat meal; so-called "whole-wheat" or "entire-wheat flour" obtained by removing part of the bran and grinding the rest of the kernel; and ordinary patent flour.

In order to make it appear that as large amounts of nutrients are obtained from the whole-wheat as from the white flour, Mr. Dutcher selects the only case where the whole-wheat and white flours were made from different wheats and so indicated in the original, and, omitting to state this, applies this single result with the very large number of results where the two flours are milled alike from the same wheat. Such a method of comparison makes an unwarranted use of my data and is unscientific.

He also states:

Professor Snyder has gone a step farther and makes the assertion that whole-wheat flour is not only less nutritious, but is actually harmful, causing diarrhea and digestive disturbances.

This is not correct. I have never made such a statement. I have repeatedly pointed out the physiological value of whole-wheat flours for correcting some cases of constipation, and also stated that when there is a tendency to diarrhea the whole-wheat bread may aggravate this disturbance, and suggested that the consumer must determine the fact. Certainly no one else can. This question can, however, be consistently raised as noted later.

In discussing scientific subjects it is unusual to suggest ulterior motives, as he has done; such a procedure is not in the domain of science.

Dutcher gives a summary of some statements in answer to a letter sent out by a "government chemist of prominence," name not given. Any prominent government chemist who at this time really has anything of value to offer would readily have his work accepted and published by the government, and it would not be necessary to get Dutcher to publish it for him. It would be interesting to know if he has presented his views and had them rejected by the government and the Food Administration.

No mention is made of others who have obtained similar results to mine, or to the fact that my work was repeated at the University of Maine by Woods and Merril and checked at Washington by the U. S. Department of Agriculture, under whose direction the tests were made. They extended over a period of ten years.

Mr. Dutcher makes a vigorous outcry against the price of bran, and advises methods of farming whereby the farmers "would never again resort to the expensive mill feeds." And this at a time when farmers are being urged to raise more wheat! The U. S. Food Administrator permits the miller to take a profit of 50 cents per ton on his bran. The above and others of his statements are made without sustaining facts.

But to return to the subject, "The Conservation of Wheat." It is argued that the wheat crop can be made to go further by using whole-wheat flour. We have an abundance of corn but a shortage of wheat. The question is then: How can we use jointly the two crops to the best advantage?

A pound of wheat by-product used as human food supplies about 500 available calories and about .05 of a pound of digestible protein. A pound of corn meal or corn flour supplies over

[1] O. E. S. Bulletin 101, U. S. Department of Agriculture.

three times as much available energy and 75 per cent. more protein.

The wheat by-product alone has no physical bread-making value; it is exactly on a par with corn meal or any other cereal product that has no gluten. Why, then, should we use wheat by-product in bread-making to conserve wheat, when corn meal, or corn flour or other cereal flours furnishes pound for pound so much more digestible protein and available energy?

The presence of the wheat by-products lowers the amount of other cereal that can be blended with flour. That is, you can not use as much corn, barley or oat flour in combination with whole-wheat flour in making bread as you can when using ordinary white flour. In the rationing of Belgium when whole-wheat flour (82 per cent.) was used, Mr. Robinson Smith, of the Commission for Relief in Belgium, in discussing corn, says:

> Its chief value as maize flour was in mixing with the wheat flour up to 11 per cent.

In our bread at the present time 25 per cent. and more corn or other cereal flour is used with white flour. The use of whole-wheat flour *reduces* the amount of other cereal that can be combined and made into bread, and also reduces the amount of available energy and digestible protein contained in the loaf.

Furthermore, wheat by-product is more completely digested by animals than by man, a pound of wheat feed in a mixed ration for animals is worth a little more than a pound of corn.

We have an abundance of corn and a shortage of wheat. Milk is a necessity as human food, also butter, eggs and meat, and these must be produced as cheaply as possible.

When man uses as a bread mixture 75 per cent. white flour and 25 per cent. corn meal or corn flour then all of the wheat by-product is available as animal food, where it is more valuable than when used as human food; while in turn the corn goes farther as human food than the by-product it replaces. This certainly is a valuable and an economical substitution of corn for wheat by-product as it benefits both the human and the animal.

If we should use whole-wheat flour only and 12 per cent. corn flour as a bread mixture, the wheat supply would not last as long as when white flour is used with 25 per cent. of corn flour.

In view of these facts it is not surprising that the U. S. Food Administrator followed the course he did in regard to regulating the milling of flour and the making of bread.

The long extraction flours of other countries are frequently mentioned as an example for the United States to follow. Surely we should profit by their example to the extent of avoiding their mistakes, but there is no reason why we should copy their mistakes and failures. France was the first country to lengthen the extraction of the wheat to 82 per cent. Recently she has gone back to the old standard. (Commerce Reports, U. S. Dept. Commerce, January 7, 1918, p. 79.) The change to long extraction was not a success. Professor Bertrand, chief of the service staff of the Pastuer Institute, has pointed out that in digestion of the long-extraction flours "there are other considerations that tend to reduce" the actual available calories, and that they have not been previously considered, namely: the loss of energy due to the "digestive work" of the "excess of inert substances" in the long-extraction flour. This factor has not been numerically determined but it would still further reduce the available nutrients of the whole wheat. The change of the French government from the long extraction of wheat as a war-time conservation measure back to normal basis is certainly significant. The experiment failed. We should profit by this failure.

The whole wheat and graham advocates usually place great stress upon their wholesomeness, richness in minerals and to certain unknown components to which the name "vitamine" has been applied. A restricted diet may have an insufficient amount of mineral matter or growth-promoting substances, improperly called "vitamines," as well as an insufficient amount or kind of protein, but in a diet with a variety and ample amount of food there is no danger whatever of any deficiency. The U. S. Public Health Service says:

It may be added that a great majority of the people of this country live on a well-balanced, sufficient, mixed diet.[2]

From a recent memorandum for the Secretary of War issued by George W. Goethals, Acting Quartermaster General of the U. S. Army, in reply to a plea for the exclusive use of whole-wheat and graham breads by our soldiers the following quotations are made:

It is recognized that particular care must be observed in the composition of bread. In order to prevent sickness among the civilian population of Italy caused by the use of whole-wheat flour, the Italian government was compelled to fix the percentage of whole wheat at 85 per cent. During the Boer War the British troops in South Africa experienced similar troubles from a like cause. This is due to the fact that the husks or outer covering of the wheat irritate the membranes of the stomach and cause increased intestinal secretions. "This is well known and our trained bakers have been taught to avoid the use of whole wheat flour when possible."

This report of Gen. Goethals is not to be considered lightly.

As to the "vitamine" deficiency of milled products, as white flour, Dr. E. V. McCollum, now of the Johns Hopkins University, in an address before the National Association of American Dairy Food and Drug officials, said:

It is time to warn against the widely heralded teaching that the several diseases recognized as of dietary origin, such as scurvy, beri-beri and possibly pellagra are necessarily due to the absence or to an inadequate supply of "vitamines." We should remember, however, the importance of the other factors of which I have spoken, and in considering the stand to be taken with respect to the milled products, keep in mind that the grains from which they are prepared are themselves singly and collectively as they come from the hand of Nature, incapable of supporting the health of an animal during growth. . . . In closing let me repeat that successful nutrition is not assured by the consumption of the foods just as they are supplied by Nature. It is to be attained only by the judicious combination of foods with a knowledge of their dietary components.

Recognizing this broader conception of nutrition and the necessity of a judicious combination of foods to effect perfect nutrition, then whole-wheat flour and white flour and the grain itself all stand on the same level, for if used either singly or collectively they fail to affect perfect nutrition.

We must conserve wheat. The best way is to use corn and other cereals. In using whole-wheat flour you are still using wheat. Whole-wheat flour has a place in the dietary. It can not, however, replace white flour. Over 90 per cent. of the ordinary whole-wheat flour is composed of white flour. The person who eats whole-wheat flour to conserve wheat only deceives himself. It is better to look the facts squarely in the face and use something else. The way to conserve is to conserve. Make absolutely wheatless meals or wheatless days. It is now necessary to do so. Let us do it cheerfully.

HARRY SNYDER

[2] P. H. Reports, Vol. 31, No. 33, p. 2205.

SCIENTIFIC EVENTS

THEODORE CALDWELL JANEWAY, BORN 1872, DIED 1917

AT a meeting of the board of scientific directors of The Rockefeller Institute for Medical Research, the following minute was adopted:

Resolved, that the scientific directors of The Rockefeller Institute record their profound sense of loss in the death of their honored and beloved associate, Theodore Caldwell Janeway, M.D., who has served on the board with devoted zeal since his election to succeed Dr. Christian A. Herter in 1911. Dr. Janeway at the height of his powers and in the midst of the most productive period of his life was stricken with pneumonia while in active service in the Medical Corps of the Army, to which, since the United States entered into war with Germany, he gave invaluable and unmeasured service. His life was sacrificed to patriotic duty rendered to his country without reserve. Dr. Janeway's period of office on the Board of Scientific Directors of The Rockefeller Institute was restricted to a brief seven years, yet its importance was very great, as he brought to its service learning, keen intelligence and broad vision.

Dr. Janeway was a highly skilled and widely read clinician, and he was also a notable exponent of the scientific method in internal

medicine. A graduate of the Sheffield Scientific School and of the College of Physicians and Surgeons, he emphasized the importance of chemistry and physics, the two sciences on which he based his clinical conceptions. Coming early under the mature and wise influence of his distinguished father, he received from him the more pure clinical and pathological impress which so much contributed to his broader development. In rapid succession Dr. Janeway became instructor in medicine at New York University and Bellevue Hospital Medical College in 1898, and Bard professor of medicine at Columbia University in 1909. During this period, in 1907, he was instrumental in founding the Russell Sage Institute of Pathology, which throughout its connection with the City Hospital was made a valuable adjunct to the courses in medicine which he conducted. It was natural and logical, because of the work he had done in internal medicine, that Dr. Janeway should be called to fill the full-time chair in internal medicine at the Johns Hopkins Medical School in 1914. The acceptance of the new professorship was made at a large financial sacrifice, but his altruistic action was wholly consonant with the broad and sympathetic attitude which he always held toward medical teaching and research.

Dr. Janeway's untimely death cut short not only a career in medicine which he had inaugurated with every promise of distinguished success, but has at the same time deprived The Rockefeller Institute of one of its ablest and wisest counsellors, and the medical profession of a great physician.

MEDICAL TERMINOLOGY

Dr. Franklin Martin, member of the advisory commission and chairman of the general medical board of the Council of National Defense, has issued the following statement:

In view of confusion arising because of different terms used in various medical groups to designate the same things it was deemed advisable that a conference be held to discuss the adoption of uniform nomenclature. Accordingly, an informal preliminary conference has been held at the office of the medical section of the Council of National Defense and it is believed that a promising start toward reaching the desired end has been taken.

In a small percentage of instances the same diseases are designated by different words. Similarly, injuries of identical nature, identical operations, procedures such as surgical dressings, diagnostic tests and methods of treatment are, in different branches and in different localities, given different names. The same symbol should be used to designate the same condition. There is also lack of uniformity in abbreviations used in various medical records, such as hospital histories, written orders and laboratory reports.

It is obvious to all medical men that, as a means of a quick understanding and saving of time in these days when time is so precious, the same nomenclature and abbreviations for all identical things should be used. The men who attended the conference were agreed as to the desirability of such entire uniformity.

A net result of the meeting, inasmuch as the Army, Navy and Public Health Service are practically in accord, was the passing of a motion that the Council of National Defense, medical section, should request the Surgeon General of the Army, the Surgeon General of the Navy, and the Surgeon General of the Public Health Service each to name a representative to confer on the matter of agreement concerning names of diseases and injuries. It was also voted that after such a list has been prepared there should be called together representatives of the leading national bodies who should have a voice in such decisions. Once a general agreement is reached the 20,000 doctors who go back to civil life after the war will automatically bring these lists into general use throughout the hospitals of the country.

Those who attended the conference were Colonel Albert G. Love (for sick and wounded records), Colonel Champe C. McColloch, Jr. (for the history of the war), both as representatives of the Army; Assistant Surgeon Charles E. Alexander, statistician for the Bureau of Medicine and Surgery, representing the Navy; Dr. B. S. Warren, statistician for the Public Health Service; Dr. W. H. Davis, of the vital statistics section of the Census Bureau; Dr. W. T. Longcope, as one who could speak for medical colleges; Dr. John W. Trask, who, as a member of the American Medical Association's Committee on nomenclature, could speak for organized medicine, and Dr. Robert L. Dickinson, of the medical section of the Council of National Defense.

LECTURES ON PUBLIC HEALTH

Surgeon-General Gorgas has arranged for a series of "Half-hour Health Talks" for the

civilian employees of the War Department, to be held Tuesday and Thursday afternoons at 4.45 o'clock, in the auditorium of the Department of the Interior building. All civilian employees of the War Department are cordially invited to attend. The following is a partial list of the lecturers and their subjects:

Thursday, April 25. "Cancer, its prevention," by Major William J. Mayo, Medical Reserve Corps, United States Army, Surgeon General's Office, Rochester, Minn.

Tuesday, April 30. "Part to be taken by women in modern sanitation," by Lieutenant Colonel W. H. Welch, Medical Corps, National Army, Johns Hopkins University.

Thursday, May 2. "Practical information for the care of the eye," by Major G. E. De Schweinitz, Medical Reserve Corps, University of Pennsylvania.

Tuesday, May 7. "Care of the foot and its proper covering," by Lieutenant Colonel E. G. Brackett, Medical Corps, National Army, Harvard University.

Thursday, May 9. "The activities of women during the present war," by Miss Annie Goodrich, Surgeon General's Office, Teachers' College, Columbia University.

Tuesday, May 14. "Focal infection in relation to general diseases," by Lieutenant Colonel Frank Billings, Medical Corps, National Army, Chicago University.

Thursday, May 16. "Food, dietetics and nutrition," by Major John R. Murlin, Sanitary Corps, National Army, Cornell University.

Tuesday, May 21. "Posture in its relation to human efficiency," by Miss M. Sanderson, department of physical reconstruction (superintendent, Boston School of Physical Education).

Thursday, May 23. "Typhoid fever and its prevention," by Colonel F. F. Russell, Medical Corps, Laboratory Division, Surgeon General's Office.

Tuesday, May 28. "Our hospital facilities and requirements," by Lieutenant Colonel W. H. Smith, Medical Corps, National Army, Surgeon General's Office, Johns Hopkins University.

Thursday, May 30. "Hygiene of the mouth," by Major Leonard G. Mitchell, Medical Reserve Corps, Surgeon General's Office.

Tuesday, June 4. "Social hygiene," by Kate B. Karpeles, Surgeon General's Office, Acting Assistant Surgeon, United States Army. (This lecture for women only.)

Thursday, June 6. "Care of the skin" (clothing, bathing, exercise), by Dr. William A. Pusey, Surgeon General's Office.

RESEARCH GRANTS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE committee on grants of the American Association for the Advancement of Science, by a practically unanimous vote, recommends the following appropriations:

$300, to Mr. William Tyler Olcott, secretary, American Association of Variable Star Observers, 62 Church Street, Norwich, Connecticut, for the purchase of a telescope of 5-inch aperture.

$250, to Professor A. E. Douglass, of the University of Arizona, Tucson, Arizona, for the length of record of tree growth of the Sequoias from about 2,200 to 3,000 years.

$500, to Professor Carl H. Eigenmann, of Indiana University, Bloomington, Indiana, for the study of the fresh-water fishes of South America.

$500, to Professor Edwin B. Frost, of Yerkes Observatory, Williams Bay, Wisconsin, for measurement and reduction of photographs of stellar spectra, already taken with the 40-inch telescope.

$200, to Dr. R. A. Porter, of the University of Syracuse, Syracuse, New York, for explanation of the hysteresis which has been observed in the potential gradients of the calcium-cathode vacuum tube.

$200, to Professor E. W. Sinnott, of The Connecticut Agricultural College, Storrs, Connecticut, for experiments to determine the ratio (in dry weight) between root, stem, leaf and fruit in the bean plant.

$500, to Professor O. F. Stafford, of the University of Oregon, Eugene, Oregon, for research on the distillation of wood.

$200, to Professor Herman L. Fairchild, University of Rochester, Rochester, New York, for the continuation and completion of his studies on the Post-Glacial continental uplift in New England and the Maritime provinces of Canada.

$250, to Professor S. D. Townley, secretary, Seismological Society of America, Stanford University, California, for the investigation of earthquake phenomena.

E. C. PICKERING,
Chairman of Committee on Grants

THE NATIONAL ACADEMY OF SCIENCES

THE National Academy of Sciences held its annual meeting April 22–24, 1918, at the

Smithsonian Institution, President Walcott presiding.

The scientific program which was printed in the last issue of SCIENCE included reports of important researches, summaries of war work connected with the National Research Council (a committee of the Academy), and the William Ellery Hale lectures on "The Beginning of Human History from the Geologic Record," by Dr. John C. Merriam, of the University of California.

At the annual dinner, held Tuesday evening at the Cosmos Club, the following medals and awards were presented:

The Comstock Prize of $1,500 for discoveries in magnetism and electricity was awarded to Samuel Jackson Barnett, Ohio State University, Columbus, Ohio.

The Draper Medal for discoveries in astronomical physics, to Walter Sydney Adams, Mount Wilson Solar Observatory, Pasadena, California.

The Daniel Giraud Elliot Medal and Honorarium, for work in paleontology and zoology, to Frank M. Chapman, American Museum, New York.

Members of the Council elected were W. H. Howell and C. G. Abbott.

The new members elected were:

Robert Grant Aitken, astronomer, Lick Observatory, California.

George Francis Atkinson, botanist, Cornell University, Ithaca, New York.

George David Birkhoff, mathematician, Harvard University, Cambridge, Mass.

Percy Williams Bridgman, physicist, Harvard University, Cambridge, Mass.

Stephen Alfred Forbes, zoologist, Urbana, Illinois.

Charles Elwood Mendenhall, physicist, University of Wisconsin, Madison, Wisconsin.

John Campbell Merriam, paleontologist, University of California, Berkeley, California.

Henry Norris Russell, astronomer, Princeton University, Princeton, New Jersey.

David Watson Taylor, engineer, Rear Admiral, and Chief of the Bureau of Construction and Repair, Department of the Navy, Washington, D. C.

John Ripley Freeman, engineer, Providence, Rhode Island.

Charles Judson Herrick, neurologist, University of Chicago, Chicago, Illinois.

Ludwig Hektoen, pathologist, University of Chicago, Chicago, Illinois.

Frank Baldwin Jewett, engineer, Western Electric Company, New York City.

Walter Jones, physiologist, Johns Hopkins University, Baltimore, Maryland.

Irving Langmuir, chemist, General Electric Company, Schenectady, New York.

SCIENTIFIC NOTES AND NEWS

THE Geological Society of France has awarded to Dr. Henry Fairfield Osborn the Gaudry Medal, which was established by the society in the year 1910 in honor of the distinguished French paleontologist, Albert Gaudry. Previous awards of the medal have been to the following paleontologists and geologists: Albert Gaudry, 1910; Marcellin Boule, 1911; Henri Douville, 1912; Eduard Suess, 1913; Emile Haug, 1914; Charles D. Walcott, 1917.

DR. LOUIS A. BAUER, director of the department of terrestrial magnetism, Carnegie Institution of Washington, has been elected a foreign correspondent member of the Royal Academy of Sciences of Netherlands India.

AT the last session of the Paris Academy of Medicine, an election was held to fill the places of Dr. Duguet and Professor Reclus in the section of internal pathology and external pathology, respectively. To the former Dr. Pierre Teissier was elected by 55 out of 62 votes, and to the latter, Dr. Felix de Lapersonne was elected by 49 out of 61 votes.

THE recalling of Dr. Allan J. McLaughlin to the United States Public Health Service to become assistant surgeon-general in charge of the Division of Interstate Quarantine, left a vacancy in the health commissionership of Massachusetts, which has been filled by the appointment of Dr. Eugene R. Kelley, who went into office on April 1. Dr. Kelley was formerly commissioner of health of Washington, and for three years past has been director of the department of communicable diseases in the Massachusetts organization.

MR. R. M. STEWART, who has been associated with the Dominion Astronomical Observatory at Ottawa since 1902, has been appointed assistant chief astronomer.

ATTENTION is called in the *American Museum Journal* to the fact that Dr. Frank M. Chapman, curator of ornithology, who is second in point of seniority on the scientific staff of the American Museum of Natural History, completed on March 1, 1918, his thirtieth year of connection with the institution. He joined as assistant curator of vertebrate zoology in 1888. "He has, from the first, devoted himself chiefly to ornithology, attaining preeminence in educational and scientific work in that branch. The effectiveness and high ecological value of the large series of habitat bird groups in the museum, which it is said by competent observers are second to no exhibits of birds in the world, are based on the careful observations made during his extensive field studies."

LIEUTENANT PETER K. OLITSKY, Medical Corps, U. S. A., and of the scientific staff of The Rockefeller Institute for Medical Research, upon permission granted him by the surgeon-general, sailed from Vancouver on April 11, for China, in response to a cabled request received by the institute from the colonial secretary at Hong Kong for assistance in a local outbreak of epidemic meningitis. Dr. Olitsky is to advise the Hong Kong government concerning the control of the disease, and especially in the preparation of an effective serum and the institution of other therapeutic and prophylactic measures.

AT the request of the South African Institute for Medical Research, The Rockefeller Institute for Medical Research has arranged with the Vermont State Department of Health to release Dr. Edward Taylor for temporary service in Johannesburg to advise the government there in respect to an epidemic of poliomyelitis prevailing in that region. Dr. Taylor sailed from New York on April 20.

DR. HERBERT J. SPINDEN, assistant curator in the department of anthropology at the American Museum, is on his way to Colombia, South America, to make a general archeological survey.

BRINGING an appeal for a doctor by Vilhjalmur Stefanson, the Arctic explorer, who lies dangerously ill on Herschel Island, a messenger reached Fort Yukon, Alaska, on April 25, after a record-breaking trip from the north. In a message carried by the courier Stefanson told of being ill fifty days, after being stricken with typhoid and pneumonia, followed by complications. A Northwest mounted policeman and two Eskimos have died of typhoid, while several others are ill. A doctor already is on his way to Herschel Island.

DR. H. C. COWLES, of the department of botany of the University of Chicago, visited the Iowa State College on April 12 and gave the annual address for the national honorary societies Phi Kappa Phi and Gamma Sigma Delta.

PROFESSOR S. W. PARR, professor of chemical engineering at the University of Illinois, recently gave an address at the Iowa State College before the Ames Section of the American Chemical Society.

THE annual oration of the Medical Society of London will be delivered by Dr. T. S. Hyslop on May 13, upon the subject of "Degeneration in Art, Science and Medicine."

A KNOLL on the University of Wisconsin campus on which John Muir, the naturalist and explorer, received his first lesson in botany under a locust tree while a student at the university, is to be officially dedicated and named "Muir Knoll." The ceremony will be held on alumni day, June 18, during commencement week.

THE deaths are announced of R. S. Trevor, lecturer on pathology and dean of St. George's Medical School, London, aged forty-six years and of G. A. Petrone, lecturer in pathology and pediatrics at the University of Naples, aged forty-four years.

CHARLES KEENE DODGE, of Port Huron, Michigan, died at Ann Arbor on March 22, in his seventy-fourth year. A correspondent writes: "For forty years he had been interested in the botany of eastern Michigan and adjacent portions of Canada, and for the last decade was unquestionably the foremost student of higher plants in these regions. He published many regional lists of plants. His

death will be deplored by all systematic botanists, as well as by all who knew his genial personality."

Dr. Ferdinand Braun, of Germany, who shared the Nobel Prize in 1905 with Guglielmo Marconi, for distinguished achievements in the invention of improved methods of wireless telegraphy, died on April 14 at a Brooklyn hospital. Death was caused by a heart attack induced by an overdose of morphine, which Dr. Braun is alleged to have taken before arriving at the hospital, to ease pain from an intestinal disorder from which he had been suffering for three years. Dr. Braun was born in Fulda, Germany, in 1850. He came to this country in 1914 as a witness in litigation between the Marconi Wireless Company and the German company which built and operated the wireless station at Sayville, L. I.

Mr. H. J. Helm, formerly deputy-principal chemist of the British Government Laboratory, has died at the age of seventy-nine years.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. J. C. Lincoln has presented to Oberlin College the Mary McKenzie Lincoln Scholarship Fund, to be used in paying the term bill of some young woman, a student in Oberlin, who desires to continue her studies at the summer school of the Marine Biological Laboratory at Woods Hole.

Through the will of the late Henry Janeway Hardenbergh, of New York, Rutgers College has received Mr. Hardenbergh's library in architecture and the sum of $20,000. Mr. Hardenbergh designed and erected Geological Hall and the Kirkpatrick Chapel, and two years ago carried out the remodelling of the chapel.

Announcement has been made that President Wilson has directed the War Department to establish an infantry unit, senior division, of the Reserve Officers' Training Corps at Columbia University.

At the University of Buffalo medical school, Dr. Edward W. Koch has been appointed professor of pharmacology and Dr. Wayne J. Atwell, professor of anatomy, both on a full-time teaching and research basis.

Miss Phyllis M. Borthwick, lecturer in physics at the Ladies' College, Cheltenham, has been appointed assistant-professor of physics and chemistry at the Lady Hardinge Medical College for Women, Delhi.

DISCUSSION AND CORRESPONDENCE

NOTE ON A REVERSE CONCENTRATION CELL

In the Nernst theory of the concentration cell the solution tension of both electrodes is assumed to be the same, but the electrode in the more concentrated part of the electrolyte is supposed to have its rate of solution retarded by the back "osmotic pressure" of its own ions.

Another possible way of regarding the phenomenon is to suppose that the electrode in the solution of higher specific inductive capacity always goes into solution faster than the other, and hence becomes the anode. From this point of view, the solution of metallic salts in water lowers the specific inductive capacity of the water, and hence the electrode in the more concentrated solution of the concentration cell becomes the cathode.

A concentration cell for demonstration purposes is often made by pouring water carefully upon a concentrated solution of stannous chloride, so that the two liquids do not mix, and placing a rod of tin in the two solutions. The tin will rapidly dissolve in the dilute solution at the top, and crystals of tin will be deposited from the concentrated solution at the bottom.

If, instead of pouring water upon the concentrated solution, a solution of stannous chloride in ether be poured upon it and the two solutions be shaken together, most of the salt in solution will go into the water and only a little will remain in the ether and water at the top. Thus the tin ions are highly concentrated in the water and are very dilute in the ether, and their "osmotic pressure" is correspondingly greater in the water than in the ether. Notwithstanding this difference of concentration, if the tin rod be placed in the two solutions, ions will dissolve off it in the

concentrated solution of its own ions at the bottom, and small crystals of tin will form upon it in the dilute solution at the top.

The specific inductive capacity of the water solution must be much higher than that of the ether solution, even after being decreased by the ions in solution, since that of pure water at room temperature is more than 75 while that of ether is less than 4.5.

The results are quite as striking when lead acetate is dissolved in the water and ether and a lead wire is used for the electrode as the tin with stannous chloride. No doubt any salt that is slightly soluble in ether may be used just as successfully as those named above.

FERNANDO SANFORD

STANFORD UNIVERSITY

HERING'S CONTRIBUTIONS TO PHYSIOLOGICAL OPTICS

TO THE EDITOR OF SCIENCE: In your issue of April 19, page 388, you announce the death of Professor Dr. Ewald Hering and refer to him as "the eminent physiologist." Permit me to add that his chief work, for which he became well known, was in physiological optics and more especially the perception of color by the eye; his work in this direction is well-known and has been frequently referred to in literature in which it was coupled with that of the famous Helmholz, with whom he was for a time a contemporary.

Early in 1911 he was knighted, at the same time that Professor Roentgen was, by having conferred upon him the decoration of the Order "Pour le Mérite" for his creditable work and scientific researches. A description of his collection of experiments demonstrating phenomena in physiological optics, some of which the writer has had the pleasure of seeing in his own laboratories in Liepzig and Prague, would make very interesting and instructive reading and ought to be published.

In one of these a band of light was thrown on a screen, which every one without hesitation would acknowledge was a bright green when, as a matter of fact, there was absolutely no green present; the sensation of green light was a purely physiological effect due to a neighboring band of its complementary color. This peculiar phenomenon has suggested to the writer that there might perhaps be some way of utilizing it to advantage in supplying an additional color to colored moving pictures.

CARL HERING

PHILADELPHIA,

REFORM OF THE WORLD'S CALENDAR

TO THE EDITOR OF SCIENCE: In SCIENCE of April 19 appears a paper advocating "A Common Sense Calendar," by Professor Howard C. Warren of Princeton University. The changes proposed by Professor Warren would certainly prove a great improvement over the present highly archaic calendar that the world is burdened with as a heritage from our remote ancestors. But Professor Warren's scheme could be farther simplified.

The subject of a reform in the calendar was agitated quite widely some half dozen years ago; and about five years ago an international commission charged with the consideration of this subject was located in Berne, Switzerland. This commission sent out invitations to all who cared to do so, to submit suggestions upon the question of reforming the calendar, and this writer had the temerity to offer a scheme for a new calendar.

This scheme embodies one very radical change, which if accepted would reduce the problem to the last degree of simplicity, to wit, the division of the year into thirteen lunar months of four complete weeks, or twenty-eight days each. It was proposed to intercalate a thirteenth month (with the suggested name of Sol) between July and August of the existing calendar.

The extra day in each year should be disposed, as suggested by Professor Warren, that is, inserted between the last day of the old and the first day of the new year. The year might be made to begin on a day more in accord with nature's harmonies, that is, in the beginning of spring instead of the middle of winter; but that is not a vital matter. The extra day to be dealt with every fourth year, to be called "Leap Day," might be conveniently inserted bewteen two of the summer months.

It can readily be seen that this scheme would synchronize the days of the week, the month, and the year, throughout.

The international commission above referred to seems to have faded out with the advent of the war.

T. G. Dabney

Clarksdale, Miss.,

SCIENTIFIC BOOKS

A Check List of North American Amphibians and Reptiles. By Leonhard Stejneger and Thomas Barbour. Cambridge, Massachusetts, Harvard University Press. 1917. 125 pages.

The check list of North American reptiles and amphibians which has recently been published will undoubtedly initiate a new period in the herpetology of the continent, for it appears opportunely and has been carefully prepared by the two foremost students of the subject.

There has long existed an urgent need for such a work. The last check list (Garman, 1884) was superseded by Cope's monographs on "The Batrachia of North America" (1889) and "The Crocodilians, Lizards and Snakes of North America" (1900) which have remained the most recent attempts toward complete lists. Cope's books contain many inaccuracies, and since their appearance the field work of a number of museums and the studies of several investigators have materially increased our knowledge of the subject. The results of recent studies have appeared in excellent monographs, such as Dickerson's "The Frog Book," Van Denburgh's "The Reptiles of the Pacific Coast and Great Basin," and Stejneger's "The Poisonous Snakes of North America," and in numerous, small, widely scattered papers, many of which are only to be found in the large libraries. The result of the unorganized condition of the subject was that only the herpetologist knew what forms were to be recognized, and, owing to the chaotic condition of the nomenclature, only the specialists who had access to the large and older collections were in position to decide upon the names that should be used.

The check list evidently is not a mere list of described forms, but represents an attempt at a rather thorough reorganization of the systematic herpetology of the area which it covers. As stated in the introduction, it "has been prepared generally upon the lines of the American Ornithologists Union Check List of Birds, and, following that example, it has included the species and subspecies which the authors deem valid and of certain occurrence in North America, north of the Rio Grande, and in Lower California, Mexico." Certainly a painstaking attempt has been made to rectify the nomenclature, and just as certainly no two investigators were better qualified for the task than Dr. Stejneger and Dr. Barbour. Their ability, experience and knowledge of the subject, evidenced in their contributions to the field of systematic herpetology, and the fact that they are curators of the two largest and oldest collections of amphibians and reptiles in America are generally known, and their names on the title page will at the same time give herpetologists confidence in the work and give the book an authority that it would not have otherwise. This is very fortunate not only because the check list was needed, but also because it was time that an authoritative work appeared which could by emendations be perpetuated as has been the check list of the American Ornithologists Union.

The arrangement of the subject-matter is excellent. It may be described as follows: The genera and higher groups are in systematic sequence; the species are in alphabetic order and only those believed to be valid are included; the names are followed by citations of their original appearance except in the case of family names, which are formed automatically; the reference to the original description is followed in the case of genera by the type species, in the case of species by a reference to the first appearance of the name in the combination adopted; under each species a reference is then given to Cope's "North American Batrachia" or "The Crocodilians, Lizards and Snakes of North America"; and finally the type locality and the range of each species or subspecies is given.

One of the features of the work that will command attention is the nomenclatural changes. Such old friends as *Diemyctilus*, *Ambystoma punctatum*, *Spelerpes*, *Bufo lentiginosus*, *Eumeces* and *Elaps*, are supplanted respectively by *Notophthalmus*, *Ambystoma maculatum*, *Eurycea*, *Bufo terrestris*, *Plestiodon* and *Micrurus*. That much abused name *Coluber*, which has probably been attributed to more groups of snakes than any other and was finally (1907) given by Stejneger to the old-world vipers of the genus usually known as *Vipera*, is now given to the racers (*Zamenis*). Perhaps the most curious changes are in the names of the northeastern hognosed snake, hitherto *Heterodon platyrhinus*, and the copperhead, generally known as *Agkistrodon contortrix*. The former becomes *Heterodon contortrix*, the latter *Agkistrodon mokasin*. It is unfortunate that it has been found necessary to make so many changes in the names, but it can not be denied that the nomenclature in these groups was in need of revision and that the only way to secure stability in nomenclature is to adhere to the rules which have been adopted for determining the names which shall be used.

The stand which the authors have taken on the question of trinomials is commendable. "As for the admission of subspecies—or rather trinomial designation—for certain forms no special attempt has been made at consistency, the authors on principle leaning towards binomials in all cases where the need of trinomials has not been clearly established." This is precisely the method which if followed will permit advancement in our knowledge of relationships in these groups. To conceal the fact that a form is a true species by the use of a binomial designation is quite as bad practise as to use trinomials loosely and thus destroy their significance.

There is abundant evidence that the writers have made a critical study of the status of the species which have been described. There will be differences in opinion here, and more particularly as our knowledge increases, but the rejection of a considerable number of forms which are not valid and which have been a source of confusion will be of distinct advantage to the student. With good judgment the authors have been conservative in this matter. They could not be expected to examine the status of all of the more recently described forms nor to make detailed studies of the genera which are notoriously difficult, and they have adopted the rule of accepting "the judgment of reliable workers . . . where no special reason appeared to contraindicate the validity of the form."

The geographic data will appeal to the student who has had to search through an extensive literature to determine the range of a form, and who has frequently encountered difficulties in determining type localities. Too often the type localities have been omitted or only generally stated in the original descriptions, and it is fortunate that in this book "The type localities are as exact as it is possible to determine." The authors admit that this can not be said of the ranges. "Many are obviously faulty, but a sincere attempt has been made to collect records of authentic captures; however, with a literature so extensive and so scattered, records have almost surely been overlooked. In many cases, our knowledge does not warrant drawing hard and fast lines delimiting a form's occurrence, and we often state ranges in purposely general terms." A perusal of the work will show that the ranges are fairly well defined. There are, however, a number of inaccuracies in the summaries, and the subject has received unequal treatment. Thus *Rana sylvatica* does not extend westward to the Great Plains, *Rana cantabrigensis* extends eastward to Wisconsin and Michigan, *Eumeces skiltonianus* is not confined to California but ranges eastward through Nevada to Utah, and the ranges as given for *Pituophis sayi* and *Natrix sipedon* are too general to be of much use. One may grant the difficulties in gathering all of the records and in drawing definite boundaries, and recognize that too much detail would make the check list cumbersome, but it is suggested that the value of the book would have been greater if the ranges of the amphibians, lizards and snakes had been as uniformly well defined

as have been the ranges of the turtles. A knowledge of the distribution is of assistance to the herpetologist for the clues to relationships which it gives, it aids the student who is not an expert herpetologist to identify his specimens, and it encourages geographical studies and the publication of local lists. In view of its importance in systematic work the subject may well receive careful attention in lists of this kind.

It should not be concluded that the value of the check list is seriously impaired by the shortcoming just mentioned. The criticism is meant to be constructive, for it must be the hope of all herpetologists that this very useful book will be the first edition of a permanent check list. That it may be, the reviewer suggests that it be officially adopted by the American Society of Ichthyologists and Herpetologists, and that the authors be appointed permanent editors.

ALEXANDER G. RUTHVEN
UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

IDENTITY OF ATOMIC WEIGHT AMONG DIFFERENT ELEMENTS

AUGUSTE PICCARD has recently suggested[1] that the "element" uranium may be composed of three isotopes, there being in addition to uranium I. and its descendant uranium II. a long-lived element of atomic weight "about 240" which is the parent of the actinium series of elements, but has no genetic connection with the uranium series. This "actino-uranium" is supposed to undergo an alpha ray change to form uranium Y, which through uranium Z gives rise to the actinium elements. The hypothesis is attractive for three reasons. It establishes the actinium series as a wholly independent series, as the Geiger-Nuttall relationships between the half-life periods and the alpha ray ranges seem to demand. It gives a plausible origin for the puzzling uranium Y. Finally, it accounts for the fact that the atomic weight of uranium, instead of being, as would be expected, just twelve units higher than that of radium, *i. e.*, 238.0, is 238.167 according to Hönigschmid's authoritative work; for Piccard assumes that the atomic weight of uranium I. itself, the chief constituent of the uranium pleiad, is 238.0 and that the admixture of the heavier actino-uranium is responsible for the higher value from the analytical determination.

This hypothesis is so attractive that Wolfke[2] has already issued a copy of the periodic table of the elements in which the actinium elements are given atomic weights which follow from the assumption that the weight of actino-uranium is 240.0. It should be pointed out, however, that this assumption tacitly involves the statement that two elements may occupy the same position in the periodic table, as is commonly accepted for the isotopes, and may in addition have identical atomic weights and yet be different elements. This is a new type of isotopism. In the lead pleiad there are seven elements with atomic weights ranging from 206 to 214, all with identical chemical properties though differing in stability and in their radiations. According to Wolfke's table not only is the range of atomic weights in this pleiad extended to 216 (for actinium B) so that it covers fully ten units of atomic weight, but there are two elements, actinium D and thorium B, both of which have an atomic weight of 212 and which are therefore identical in atomic number and atomic weight, and yet the former is apparently stable while the latter has a half-life period of 10.6 hours and emits beta rays. Actinium C^1 and thorium A form another such a pair of elements, actinium X and mesothorium 1 still another, while the identity between radioactinium and thorium itself is perhaps even more striking. With the same atomic number and atomic weight, they are chemically inseparable, they both give alpha rays, yet their periods are 18.9 days and 1.5×10^{10} years, respectively, and their descendants are quite distinctive.

According to this hypothesis, then, the atomic weight is almost wholly devoid of in-

[1] *Archives des Sciences Physiques et Naturelles*, 44, 161–64, 1917.

[2] "Ueber den inneren Bau der Atome," Zurich, 1917.

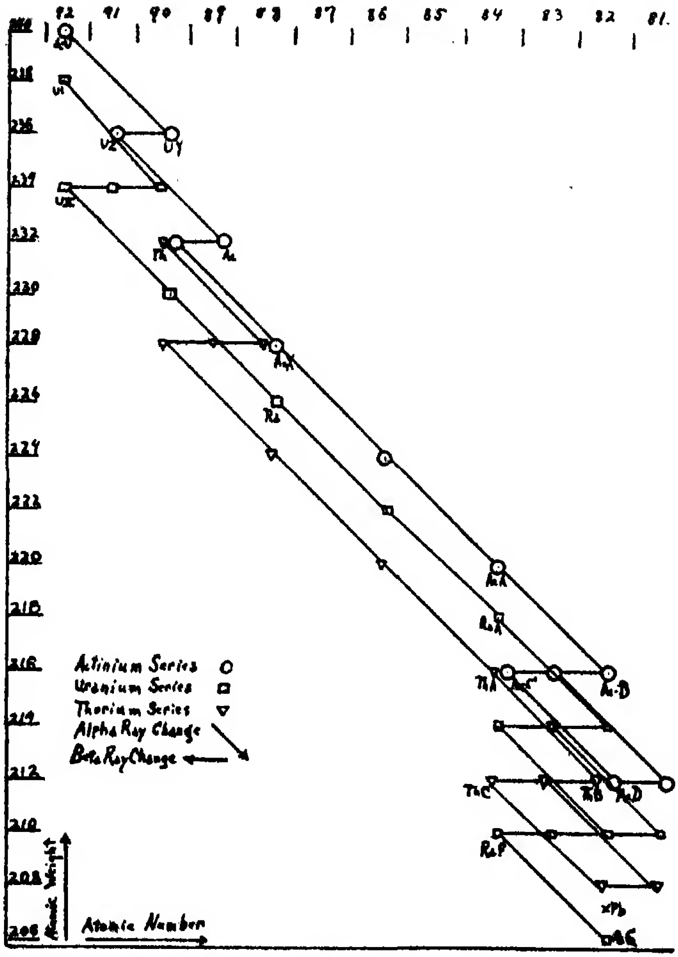


FIG. 1.

fluence on the internal properties of the atom and is solely a mass effect. All the intra-atomic characteristics, both chemical and physical, are dependent on details of atomic structure, on subatomic structural isomerism, which requires much further elucidation. There is nothing improbable about this view. Yet Piccard's suggestion by no means requires it. Until this further consequence of the theory of isotopes is experimentally verified Piccard's hypothetical actino-uranium will serve just as well if we assume its atomic weight to be 239 or 241 and thus avoid this theoretical elaboration.

GERALD L. WENDT
THE UNIVERSITY OF CHICAGO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MINUTES OF THE COMMITTEE ON POLICY

The committee met at the Cosmos Club, Washington, at 5.35 P.M., Monday, April 22, 1918, with Mr. Nichols in the chair and Messrs. Noyes, Woodward, Humphreys, Cattell, Ward and Howard also present. The minutes of the meeting of December 30, 1917, were read and approved. The permanent secretary reported concerning the present condition of the membership and a brief discussion followed on general conditions.

The election of Mr. John Barrett as a fellow and as vice-president of Section I was con-

firmed. Dr. Aleš Hrdlička was elected as vice-president of Section H.

On motion, the sum of four thousand (4,000) dollars was appropriated to the committee on grants, with the suggestion that the committee use this amount with especial care. On motion, the treasurer was authorized to invest spare funds in government Liberty Bonds, the amount reported by him being in the neighborhood of one thousand (1,000) dollars.

After extended discussion as to the time and place of the next meeting, in which letters from President Lowell, of Harvard, and President Maclaurin, of the Massachusetts Institute of Technology, were read, and in which the permanent secretary reported the result of his visit to Boston to consult with leading Boston members, it was resolved that the place of the next meeting be changed from Boston to Baltimore, provided satisfactory arrangements can be made with the authorities of Johns Hopkins University.

On motion, it was resolved that a subcommittee be appointed to consult and report on a general plan for the next meeting. The permanent secretary and Messrs. Humphreys and J. C. Merriam were appointed as members of this committee, with authority to consult with other individuals and to add to the committee if found desirable.

A letter from Dr. S. A. Courtis was read relative to the Emergency Council of Education and the permanent secretary was authorized to ask Dr. E. F. Buchner to represent the Association at the next meeting of that organization.

The requests of the Seismological Society of America and the Optical Society of America for admission to affiliation were acted upon favorably and it was resolved that non-members of these societies be admitted to the Association during this year without the payment of the entrance fee.

On motion, it was resolved that the New Orleans Academy of Sciences be admitted to affiliation with the association or, if the Academy prefers, the permanent secretary was authorized to arrange for its establishment as a local branch of the association.

On motion, the permanent secretary was authorized to accept for the association "organization membership" in the American Metric Association and to pay the $10 fee for the association.

After some discussion, the permanent secretary was authorized to have the composition of the responsible editorial committee of the journal Science completed by the substitution of the newly elected vice-presidents for those of last year and to add the name of Henry B. Ward to the representatives of Section K, and the permanent secretary was authorized to have this list manifolded to send to members who request information concerning the composition of the committee.

On motion, the committee resolved that the committee on grants consist of nine (9) members to be elected by the council at the next annual meeting: three for one year, three for a term of two years, and three for a term of three years; thereafter, three members to be elected annually for those whose terms expire, with the proviso that not all of the three shall be reelected, and that the council shall designate the chairman and the secretary of the committee.

At 9.15 P.M., the committee adjourned, to meet at the call of the chairman, with the understanding that it may be desirable to hold the next meeting during the third week of November at Baltimore in case emergency does not demand an earlier meeting.

L. O. Howard,
Secretary

SECTION M—AGRICULTURE

This Section held two sessions at the Pittsburgh meeting, in Thaw Hall, University of Pittsburgh, one on the afternoon of December 28 and the other on the morning of December 29, 1917. At the latter session the address of the retiring Vice-president of the Section, Dr. W. H. Jordan, was presented, the subject being "The Future of Agricultural Education and Research in the United States."[1]

The feature of the session on the afternoon of December 28 was a symposium on "Factors Concerned in an Increased Agricultural Production."

[1] Science, N. S., Vol. XLVII., p. 125.

Considering the subject from the standpoint of "The present status of production," Dr. John Lee Coulter, of West Virginia, reported that of the total land area of continental United States, 1,900,-000,000 acres, approximately 900,000,000 acres, or less than half, is in farms. Of the latter only about half is improved land, much of the balance not even being used for pasturage. Of the improved land, about 90,000,000 acres is used for pasturage, some 20,000,000 acres around buildings is not productively employed, and another 40,000,000 acres annually lie fallow; *i. e.*, some 150,00,000 acres are not employed to their limit.

Improvement, he felt, should begin with these areas, and he did not favor at this time expansion into new areas requiring heavy expense and labor for development through drainage, irrigation, removal of stumps and stones, etc. There was ample opportunity for all the necessary and possible increase within the limits of farms already in active operation. In an emergency like the present, state and national governments should encourage concentration of effort, especially labor, in the more productive agricultural areas, in order that the largest amount of farm products may result. The drainage of improved farm lands was advocated as one of the effective means of making efforts more productive, and also liming to sweeten the soil on millions of farms. It was advocated that during the war the government "devote all funds which can be intelligently expended in the promotion of agriculture on farms already in active use. This will include help in the matter of drainage, lime, fertilizers, seed, machinery and, above all, agricultural labor."

Referring to the effects of the tenant system, it was argued that more studious care on the part of the land owners through supervision could do more toward increasing production than most any other means.

The "Obstacles to enlarged production" were set forth succinctly by Professor W. D. Hurd, of Massachusetts. These cover a wide range and their enumeration showed the great extent to which the producers of the country are required to cope with difficulties, some of which inhere in the status of the industry and many of which are outside of human control.

Conspicuous among the obstacles to enlarged production are the systems of management which farmers are following, unwise and inefficient marketing, the enormous losses from plant diseases and insects and other pests such as rodents in the fields and storage buildings, the ravages of animal diseases, and the lack of adequate supply of farm machinery and equipment. The inadequacy of good farm labor, which has become very acute in many sections, was instanced as one of the chief obstacles at the present time. The possible means of relieving this situation and the efforts which the state and federal governments and other agencies are making in that direction, were detailed.

Other obstacles were noted which have arisen out of war conditions, such as the shortage of seed of various kinds, the lack of fertilizers in sufficient quantity, the shortage and high price of feeding stuffs, transportation difficulties, etc. Again, lack of necessary working capital and the absence of efficient organization among farmers to meet the organized forces with which they have to contend in their outside dealings, are elements of weakness which tend to restrict production and to make an increase more difficult.

Among uncontrollable factors are those of climate and season, the effects of which were cited, for example, in the large percentage of soft corn the past year, and the reduction in the area of winter wheat which it was possible to sow or bring through the past wnter.

Professor Hurd gave many interesting illustrations of what is being done to overcome many of the difficulties under which farmers are laboring and to aid them in meeting such as can not be eliminated or reduced. This made a remarkable showing of organized effort for relief and assistance, extending over the whole range of the agricultural industry, from which much was predicted in increasing the output of the nation's agriculture.

In discussing "The limiting factors in production" Director Charles E. Thorne, of Ohio, pointed out that increased production must be accomplished either through increase of area or by increased yield per acre. Increase in area involves a corresponding increase of capital and labor and is limited by the land which may be profitably added. The latter limit, it was felt, has been nearly or quite reached. The chief limiting factors in crop production were stated as (1) inadequate drainage of lands in cultivation, against which two obstacles have been removed, by providing capital through the farm loan banks and machinery to simplify the labor problem; (2) deficiency of lime in many soils, the remedy for which is associated with problems of labor and transportation; (3) neglect of crop rotation, which both scientific research and actual farm practise have demonstrated to be necessary in growing cereals economically;

(4) phosphorus hunger, a fundamental factor, since "in no other way can the production of wheat be increased as quickly and as effectively as by placing an abundant supply of acid phosphate within the reach of the farmers [east of the Mississippi] at a reasonable price"; (5) insufficient transportation—to meet the needs of drainage, liming, fertilizing and other supplies, as well as the movement of products; and (6) labor deficiency, which limits improvement in all directions.

Despite the development of farm machinery and scientific methods of farming, human labor is indispensable, and "each improvement in machinery or in method has made it more and more necessary that that labor be something more than mere brawn." Even common labor unskilled in farm work, it was pointed out, is not to be had at wages which the prices of farm products justify. It was maintained that the increased production of food is dependent chiefly upon such coordination of wages and prices of farm produce that the cost of the increased production may not be greater than its market value, and upon such coordination of transportation activities that the farmer may obtain the tile, lime and fertilizers essential to an enlarged production. The thesis was laid down that "in the present emergency the production of food is not less important to the nation's life than the production of munitions or carrying the rifle," and further that, "if food production is to be maintained the prices of farm products must be such as to permit the payment of wages corresponding to those paid in the production of munitions." To meet the necessities of war, the speaker went so far as to advocate selective conscription of labor for the production, manufacture and transportation of food and munitions, contending that selective conscription for the necessary support of the military service is equally defensible with selective conscription for military service.

In considering the subject from the broad standpoint of "The human element," Mr. Herbert Quick, of the Federal Farm Loan Board, developed a strong, logical argument for education suited to the agricultural industry and its environment. Starting with the now recognized fact that the hands are controlled by the mind, and that the mind back of the operation is far more important than the body, he contended that this faculty must be trained and guided to make it effective and to develop in it a proper attitude toward its occupation and environment. Men are bound to their occupations by a variety of elements, and it is not alone the financial side which makes a calling attractive. Traditional respect binds people to an occupation, as in the case of the professions. Public appreciation of what one is doing is another factor in binding men to their work, and agreeable environment is often another important consideration. But the thing that most of all binds a man to his occupation is that it engrosses all of his powers, that it brings into action every power of his being.

Farmers have been largely deprived of these stimulating influences. They have been looked down upon historically, as is shown, for example, by the origin of many common words in our language. Their art has been based largely on tradtion and experience. Their environment has been hard and neglected. And schools have been prescribed for them and books employed which have educated children away from farming and caused them to look to other walks of life for careers which would engross their powers, bring appreciation and position, and return a large measure of satisfaction.

Conditions are now changing. Already the attempt at agricultural teaching has shown its advantage in making the farming occupations more attractive, more gratifying, and a source of pride, and in producing more effective workers. Where the country school is right the children stay in it longer and feel a real pride in it. Where properly developed, it was predicted that it will turn the tide and retain the children in the country. Its position is a fundamental one and it will affect all rural industries and institutions. The permanent basis of increased agricultural production is the development of the farm people and especially the children; and most important of all, for permanent advancement "we need in this country a farm population engaged in a grapple with its own problems." The accomplishment of these ends was placed back on the country school.

The officers of the Section elected for 1918 were as follows: Vice-president, Dr. H. P. Armsby, director of the Institute of Animal Nutrition, State College, Pa.; Member of the General Committee of the Association, Dr. R. A. Pearson, Assistant Secretary of Agriculture; Member of the Council of the Association, Dr. C. E. Marshall, Massachusetts Agricultural College, Amherst, Mass.; Member of the Sectional Committee (for five years), Dr. John Lee Coulter, dean of the college of agriculture, West Virginia University.

E. W. ALLEN,
Secretary

SCIENCE

Friday, May 10, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE[1]

I have the honor, in the absence of Dr. Raymond F. Bacon, director of the Mellon Institute, who was commissioned as a lieutenant-colonel and is now in command of the Chemical Service Section of the National Army in France, to report to Science on the growth of the industrial fellowship system of the Mellon Institute, University of Pittsburgh.

During the past year, twenty-one members of the institute, including the director, as noted above, and an assistant director, Mr. William A. Hamor, who was commissioned as major and is aide to Lieutenant-Colonel Bacon, have entered government service in response to their country's call. The following is a list of the Industrial Fellows who have gone direct from the Institute into service:

F. O. Amon, First Lieutenant, Sanitary Corps.

H. S. Bennett, First Lieutenant, Sanitary Corps.

C. O. Brown, Captain, Ordnance Department.

A. S. Crossfield, First Lieutenant, Sanitary Corps.

R. F. Ferguson, Private, Ordnance Department.

G. F. Gray, Captain, Signal Corps.

R. B. Hall, Second Lieutenant, Chemical Service Section.

W. J. Harper, Second Lieutenant, Sanitary Corps.

C. E. Howson, First Lieutenant, Sanitary Corps.

C. N. Iry, Second Lieutenant, Engineers Corps.

E. H. Loeb, Second Lieutenant, Ordnance Department.

[1] For previous reports on this subject, see Duncan, Science, N. S., Vol. XXXIX. (1914), 672; Bacon, *ibid.*, XLIII. (1916), 453, and Bacon, *ibid.*, XLV. (1917), 399.

R. W. Miller, First Lieutenant, Sanitary Corps.

L. H. Milligan, Second Lieutenant, Ordnance Department.

R. V. Murphy, First Lieutenant, Sanitary Corps.

B. H. Nicolet, Captain, Chemical Service Section.

A. H. Stewart, Cadet, Aviation Section.

H. L. Trumbull, First Lieutenant, Ordnance Department.

W. E. Vawter, First Lieutenant, Sanitary Corps.

C. L. Weirich, First Lieutenant, Sanitary Corps.

In a number of instances, industrial fellows at the Institute, through the patriotism of the donors of their fellowships, have been giving part or, in some cases, all of their time to work on war problems which have been assigned to the institute by the National Research Council. The results obtained on some of the industrial fellowships have had opportune application to some pressing war problems. On these fellowships, no money is being spared by the donors or the institute to make the results of service to the government.

The institute, in most cases, has been able to fill the vacancies on the industrial fellowships, which were caused by the fellows entering military service. However, the shortage of research men, of the type demanded by the industrial fellowship system, has forced the institute to hold in abeyance a number of very desirable research problems. It is gratifying to report that, notwithstanding the unsettled condition of the business world, an increasing number of industrialists are assigning problems on their processes and products to the institute.

The following table shows the number of industrial fellowships which have been founded in the institute from March to March of each year—1911 to 1918; the number of researchers or industrial fellows, as they are called, who have been employed on these fellowships; and the total amounts of money contributed for their maintenance by industrial concerns:

March to March	Number of Fellowships	Number of Fellows	Amounts Contributed
1911–1912	11	24	$ 39,700
1912–1913	16	30	54,300
1913–1914	21	37	78,400
1914–1915	21	32	61,200
1915–1916	36	63	126,800
1916–1917	42	65	149,100
1917–1918	42	64	172,000

The number of industrial fellowships, noted in the table above, gives very little idea of the real scope of the service of the institute. At the present time there are six national trade associations which have fellowships in the institute. These associations have in their membership over two thousand firms. The institute especially welcomes fellowships from associations, as it is permitted in this way to be of service to a large number of companies which, individually, could not afford to found a fellowship. The institute is glad to note that national trade associations have been quick to realize the value of industrial research and are fostering it in a number of different ways.

The following is a list of the industrial fellowships in operation at the institute on March 1, 1918:

A LIST OF THE INDUSTRIAL FELLOWSHIPS IN OPERATION AT THE MELLON INSTITUTE ON MARCH 1, 1918

Numbers and Names of Industrial Fellowships in Operation	Industrial Fellows, Names and Degrees	Foundation Sums and Dates of Expiration
No. 92. Leather Belting	E. D. Wilson (Ph.D., University of Chicago).	$3,800 a year. April 1, 1918.
No. 95. Magnesia	G. D. Bagley (E.E., University of Illinois).	$4,750 a year. November 1, 1918.
No. 99. Glyceryl Phosphates	F. F. Rupert (Ph.D., Massachusetts Institute of Technology).	$1,500 a year. Bonus: 10 per cent. of profits. October 1, 1918.
No. 102. Fruit Juice	R. R. Shively (Ph.D., University of Pittsburgh).	$5,000 a year. April 1, 1918.

No. 114. Enameling	R. D. Cooke (M.S., University of Wisconsin).	$2,200 a year. April 1, 1918.
No. 115. Bread	*H. A. Kohman* (Ph.D., University of Kansas), Senior Fellow. R. R. Irvin (M. S., University of Kansas). (Vacancy.)	$7,500 a year. Bonus: $10,000. March 1, 1919.
No. 116. Refractories	*R. M. Howe* (M.S., University of Pittsburgh), Senior Fellow. (Vacancy.)	$6,000 a year. May 1, 1918. Bonus: $500.
No. 117. Window Glass	A. C. Nothstine (B.S., Ohio State University).	$3,000 a year. Bonus: $2,000. June 1, 1918.
No. 118. Leather Soling	C. B. Carter (Ph.D., University of North Carolina).	$3,500 a year. June 4, 1918.
No. 119. Iron Ore	F. M. McClenahan (M.A., Yale University).	$3,000 a year. June 15, 1918.
No. 120. Dental Products	C. C. Vogt (Ph.D., Ohio State University).	$2,400 a year. Bonus: Royalty on sales. July 1, 1918.
No. 121. Copper	C. L. Perkins (B.S., New Hampshire College). J. W. Schwab (B. S., University of Kansas).	$5,400 a year. July 1, 1918.
No. 122. Soda	C. W. Clark (Ph.D., University of Pittsburgh).	$3,500 a year. September 1, 1918.
No. 123. Oil	Harry Essex (Ph.D., University of Göttingen). I. W. Humphrey (M.S., University of Kansas). (Vacancy.)	$10,000 a year. Bonus: $10,000. September 1, 1918.
No. 124. Cement	E. O. Rhodes (M.S., University of Kansas).	$4,000 a year. Bonus: $3,500. August 1, 1918.
No. 125. Hair	B. A. Stagner (Ph.D., University of Chicago).	$3,000 a year. October 1, 1918.
No. 127. Collar	H. D. Clayton (B.A., Ohio State University).	$2,800 a year. October 1, 1918.
No. 128. Coffee	C. W. Trigg (B.S., University of Pittsburgh).	$1,800 a year. Bonus: 2 per cent. of gross receipts. October 1, 1918.
No. 129. Illuminating Glass	A. H. Stewart (A.B., Washington and Jefferson College). (On leave of absence.)	$900 a year. October 1, 1919.
No. 130. Food Container	F. W. Stockton (A.B., University of Kansas).	$5,000 a year. October 16, 1918.
No. 131. Gas	*J. B. Garner* (Ph.D., University of Chicago), Senior Fellow. (Vacancy.)	$7,500 a year. September 15, 1918.
No. 132. Yeast	F. A. McDermott (M.S., University of Pittsburgh). Ruth Glasgow (M.S., University of Illinois). T. A. Frazier (B. Chem., University of Pittsburgh). P. H. Brattain. I. S. Hooker (B.S., University of Pennsylvania).	$12,700 a year. Bonus. November 1, 1918.
No. 133. Glass	E. E. Bartlett (Pet.E., University of Pittsburgh).	$3,000 a year. November 1, 1918.
No. 134. Glycerine	J. E. Schott (M.A., University of Nebraska).	$3,000 a year. November 15, 1918.
No. 135. Fiber	J. D. Malcolmson (B.S., University of Kansas).	$2,500 a year. November 15, 1918.
No. 136. Copper	*G. A. Bragg* (B.S., University of Kansas), Senior Fellow of all Copper Fellowships. (Vacancy.)	$5,000 a year. November 1, 1918.
No. 137. Toilet Articles	L. M. Liddle (Ph.D., Yale University).	$3,500 a year. December 1, 1918.
No. 138. Silicate	M. G. Babcock (M.S., Iowa State College).	$2,500 a year. December 1, 1918.
No. 139–A. Organic Synthesis	*G. O. Curme, Jr.* (Ph.D., University of Chicago), Senior Fellow. J. N. Compton (M.S., Columbia University). H. R. Curme (B.S., Northwestern University). E. W. Reid (M.S., University of Pittsburgh).	$10,000 a year. Bonus: $5,000. January 1, 1919.
No. 139–B. Organic		

Synthesis	*H. A. Morton* (Ph.D., University of Pittsburgh), Senior Fellow. C. J. Herrly (B.S., Pennsylvania State College).	$5,000 a year. Bonus: $5,000. January 1, 1919.
No. 140. Silverware	H. E. Peck (B.S., Clarkson Memorial College of Technology).	$2,500 a year. December 11, 1918.
No. 141. Insecticides	O. F. Hedenburg (Ph.D., University of Chicago).	$3,000 a year. January 1, 1919.
No. 142. By-products Recovery	Walther Riddle (Ph.D., University of Heidelberg).	$3,000 a year. January 1, 1919.
No. 143. Coke	*F. W. Sperr, Jr.* (B.A., Ohio State University), Advisory Fellow. Marc Darrin (M.S., University of Washington). O. O. Malleis (M.S., University of Kansas). L. R. Office (B.S., Ohio State University).	$7,000 a year. January 1, 1919.
No. 144. Fertilizer	H. H. Meyers (B.S., University of Pennsylvania).	$3,000 a year. Bonus: $5,000. January 5, 1919.
No. 145. Soap	(Fellow to be appointed.)	$2,000 a year. January 5, 1919.
No. 146. Glue	R. H. Bogue (M.S., Massachusetts Agricultural College).	$2,500 a year. January 5, 1919.
No. 147. Distillation	David Drogin (B.A., College of the City of New York). H. F. Perkins.	$5,300 a year. January 18, 1919.
No. 148. Tobacco	W. B. Pattison (M.A., University of Nebraska).	$2,100 a year. Bonus: $2,000. February 1, 1919.
No. 149. Laundry	*H. G. Elledge* (M.S., University of Pittsburgh), Senior Fellow. K. R. Beach (A.B., Southwestern College).	$5,000 a year. February 15, 1919.

It required the cataclysm of the Great War to bring men to realize fully the part which applied science is playing and, more particularly, will play in the life of nations. As men have come to know that everything in modern warfare is controlled in a large measure by science—no gun of large caliber is located or fired without its aid—so they have come to know that in the making of things—in the economy and progress of manufacturing operations—science must have a place, an important place too. With this idea in mind, institutions of learning and industries in this country, but more especially abroad, are investigating and studying methods to bring about cooperation between science and industry. The Mellon Institute is proud that, while very young, it has been a pioneer in the field. Its principal claim to distinction, apart from its contributions to specific industries, is based on the service it has been able to render to other institutions in demonstrating the practicability of a system which brings together science and industry for the development of a future and more gracious civilization.

The administration of the Mellon Institute is now constituted as follows:

Raymond F. Bacon, Ph.D., Director (on leave of absence);

Edward R. Weidlein, M.A., Associate Director and Acting Director;

E. Ward Tillotson, Jr., Ph.D., Assistant Director;

John O'Connor, Jr., M.A., Assistant Director;

William A. Hamor, M.A., Assistant Director (on leave of absence);

David S. Pratt, Ph.D., Assistant Director;

Martin A. Rosanoff, Sc.D., Head of the Department of Research in Pure Chemistry.

E. R. Weidlein,
Acting Director

Mellon Institute of Industrial Research,
University of Pittsburgh,
March 1, 1918

THE EFFECT OF CATTLE ON THE EROSION OF CANON BOTTOMS

To every explorer in the arid cañon country of southern Colorado the steep-walled arroyo trenched in the center of the flat alluvium bottom is a familiar sight. Its vertical banks many times twenty or twenty-five feet high in the soft crumbling soil are no mean impediment to travel and its sandy or stony bottom is a source of constant anxiety to the freighter. Every storm fills this miniature

gorge with a rush of turgid mud-laden water and even when the rain has passed there is in the air the continual dull crash of the caving banks. At places the arroyo fills all the cañon bottoms, at others it is a mere crack in a wide expanse of alluvium, but it is continually encroaching on the bottom land. The depth of the erosion varies greatly and is controlled apparently by the distance of bed rock from the alluvium surface (which is governed by the amount of alluvial filling that had taken place) and by a fixed minimum grade which is determined by the amount of overloading of the stream and the grade of bed rock. This minimum will become smaller therefore as the alluvium is gradually removed from the cañon bottoms. The maximum depth of erosion observed by the writer is twenty-five feet, the average is probably about ten feet. The former is reached in exceedingly narrow cañons such as the upper Chaquaqua Cañon, and that of the Purgatoire in southeastern Colorado and Yellowjacket and Sandstone Cañons in southwestern Colorado. The arroyos are formed only along intermittent streams. The cañons of McElmo Creek and the Purgatoire River seem to have been dry at least part of the summer in the early days (although they now flow water all the year around) and for this reason they exhibit the arroyo at the cañon bottom.

The steepness of the alluvial banks testifies to the recent origin of these arroyos. What caused them to appear so suddenly? Rarely is it that the processes of erosion are disturbed yet it appears that the disturbance which caused these arroyos has taken place during the last sixty years. The settlers who first entered these cañons found the bottom lands low and rounded with no suggestion of an arroyo at the center. The writer has talked with pioneer ranchers both in southwestern and southeastern Colorado and on this point they are unanimous. The arroyos have developed since their advent. To this may be added this further physical evidence:

1. Along the bottoms of Yellowjacket, Sandstone and Hovenweep Cañons in southwestern Colorado the arroyos are cutting into the ruins of Indian houses (stone) which are extremely old as they represent a civilization much like that of the Zuni while the Utes have occupied this region since the time of historic record. The houses were built on alluvial flats and it is only recently that the streams have cut into them.

2. Old roads and trails frequently cut straight across gullies which it is now impossible to cross. (Southeastern and southwestern Colorado).

3. Along the sides of the cañon wall where the alluvium has been completely removed from the cliff sides the imprint of roots still remains (Chaquaqua Cañon—Southeastern Colorado.)

4. The fact that water is more abundant in the cañon bottoms now than previously seems to have a bearing on this subject In the early days (1860–1865 in eastern Colorado) (1870–1880 in western Colorado) water appears to have been very scarce in these cañons. This would seem to be due to the water flowing under a heavy alluvium cover as the precipitation records indicate no perceptible climatic variation. The formation of these arroyos seems to have uncovered a number of these hidden flows of water.

5. No alluvial terraces are found. The cañon floor is usually very nearly flat. If these arroyos were cyclic, we should expect to find a series of terraces representing a series of stages in the erosion of this alluvium. Such is not the case, even in comparatively wide cañons. The usual cañon rock terraces represent cycles exceedingly remote when compared with the one under discussion.

Comparisons of the drawings and photographs of government reports of 1860 to 1870 with recent photographs confirm this hypothesis, as the older reports do not seem to show any arroyos like those now developed.

The development of these arroyos seems to have been, therefore, contemporaneous with development of ranching. To what must we ascribe them then? The writer believes they are caused by cattle. Cattle influence erosion in two ways: first by the wearing of trails; second by the destruction of vegetation.

Cattle make trails along the line of easiest passage, usually the center of a cañon. They differ from the wild animals in that they are not hunted by man and must not shun narrow confined places, but actually converge toward them. Their trails grow rapidly and the writer can recall many which are five feet wide and a foot and a half deep. These trails effect erosion in two ways. First they form channels for the passage of water; second because of the absence of vegetation they form channels of easy erosion. Their compact surfaces are also hard places for the water to sink into the soil. During a heavy shower it is noticeable that water starts to form pools in these trails long before the surrounding surface shows the slightest sign of having reached its saturation point. When the storm becomes heavy each one becomes a miniature torrent and rapid erosion takes place in much the same manner as it does on a steep country road and finally small gullies are worn. Where rounded gullies are already present the walls are broken down and the vertical-walled arroyo finally results.

The influence of cattle on the vegetation of cañon bottoms as a whole is rather difficult to estimate, yet it must be considerable. The writer has seen in cañon pockets inaccessible to cattle deep grass so matted and tangled as to preclude any thought of erosion and cause maximum absorption, while in the same cañon where the cattle have ranged, the bottom is nothing but a tramped field of dust which offers maximum opportunity for erosion and minimum opportunities for absorption. This is particularly true in the mid summer and autumn months when cloud-bursts are frequent. We may, therefore, summarize the effect of cattle by saying that they increase the rapidity of the run-off and the rate of erosion by destroying vegetation, by compacting the soil and forming channels for the passage of water.

The introduction of this new element produced a disturbance in the nicely balanced forces of erosion so that the alluvial flats of the cañon bottoms were no longer planes of equilibrium. The increased volumes of water that swept down the cañons demanded larger channels. These the trails and the small gullies which grew from the trails, supplied, until finally the process formed the arroyos we meet to-day. The present cycle is one of readjustment. In wide cañons the alluvium will be cut away until the width of the stream course becomes so great that water will lack the force to erode and the final channel will be a rounded one of somewhat lower grade and much closer to bed rock than the present one. In narrow cañons the alluvium will be entirely removed (along Chaquaqua Creek this has already taken place) and the stream erosion grade will be formed. Of course this process is small by the side of the great base leveling which is taking place in these regions, but it is interesting in that it shows the extreme nicety with which the forces that erode are balanced. It also shows rather forcibly one of the effects of the influences of human industry on the topography. Its economic effect is not as great as that of deforestation, but it will result in the ultimate abandonment of many small farms along some of the streams. For these reasons it is deserving of further investigation.

James Terry Duce
University of Colorado

AN EMERGENCY SUPPLY OF RUBBER

The department of botany of the University of California has undertaken a study of certain West American shrubs belonging to *Chrysothamnus* and other genera of the Compositæ to determine whether or not an emergency or supplementary supply of rubber exists in such native plants. This investigation is one of the projects of the botanical subcommittee of the Pacific Coast Research Conference acting under the Council of Defense of the State of California. Results thus far obtained indicate that the total amount of rubber present in these native species is considerable, but that the percentage yield of individual plants is too small to render its extraction profitable at present prices. If, however, the importation of raw rubber should be curtailed through enemy action, this emergency supply existing within

the border of the continental United States could be utilized. It might be noted here that the quality of this new rubber is, according to rubber experts, somewhat better than the best grades of guayule, but not as good as Para.

The choice of *Chrysothamnus* and related genera as the plants first to be investigated was the result of a preliminary examination made in 1904. In September of that year the late Judge A. V. Davidson, of Independence, Inyo County, California, sent some twigs to the Department of Botany for identification, with the information that the Indians prepared from the plant a sort of "gum" which they chewed. The plant was a species of *Chrysothamnus* of the *graveolens* group. Further samples were submitted at our request, and in October, 1905, a preliminary chemical examination of them was made by Professor G. E. Colby, of the California Experiment Station. This examination indicated the presence of rubber, but not in sufficient amount to warrant further investigation. A report to this effect was made public in the press and as a result some further examinations were made by at least one commercial rubber company. The matter was soon dropped, however. It is probable that the plants used in this commercial examination were of an entirely different species from those now being examined.

During the past year some 200 different plants have been studied in detail, both in the field and in the laboratory. As a result it can now be definitely stated that many species of *Chrysothamnus* (formerly known as *Bigelovia* and commonly called rabbit-brush, or golden-bush) carry rubber in at least small quantities and that it occurs also in three species of *Ericameria* and in one species of *Stenotus*.

One species of *Ericameria* carries 9.5 to 10 per cent. of pure rubber, in addition to about 9 per cent. of acetone-extractable resins, etc. Although this plant possesses agricultural possibilities, it is too small and occurs too sparingly to be considered as a source of wild rubber. In six species of *Chrysothamnus* the older parts carry from 3 to 5 per cent. of rubber. This percentage is for dry rubber and does not include the resins or other acetone-soluble impurities. The term "species" is here used in a narrow sense. The six species referred to are all allies of *C. nauseosus*, *C. graveolens*, or *C. teretifolius*. Further taxonomic studies will be necessary before final determinations can be made, since some of the forms do not correspond to any of the described species.

The most important of these species is a large shrub, the rubber-producing portions of which commonly weigh from two to ten pounds, with a maximum observed weight of about sixty pounds. It forms nearly pure stands of considerable extent in some parts of the Great Basin Area. Histological examinations indicate that the rubber content is fairly uniform throughout its distribution. Much care must, however, be exercised to avoid confusion with closely similar forms, some of which exhibit marked fluctuation in their rubber content, while others uniformly carry not even a trace of this substance. Professor P. L. Hibbard, of the California Experiment Station, who has made the chemical analyses, reports for the most important form as follows:

	Acetone Extract, Per Cent.	Bensol Extract. Per Cent.
Plant 1, base of stem	3.74	5.06
Plant 2, base of stem	3.90	4.40
Assorted plants, trunk and root bark	3.90	7.80

These figures are for fairly dry shrub. If based upon perfectly dry shrub the percentages would be somewhat higher.

Field experiments have been instituted to determine the possibility of inducing a greater growth of the rubber-bearing tissues and also to determine whether or not it is feasible to harvest the rubber without killing the plants. Some attention is also being paid to the possibility of bringing the plants under culture for commercial purposes.

It is now proposed greatly to extend the scope of the investigation and to include many more species. In addition to locating the principal supply of the more promising species and its extent, we hope to study more inten-

sively their ecologic behavior, seasonal variation, reproduction, and other points of scientific as well as economic interest. We shall, therefore, be extremely grateful for samples from any district in which the plants grow, and shall be pleased to send instructions for the taking of these. However, even a small portion of the basal part of the stem will be helpful, since this will enable us to make a preliminary examination to determine the desirability of securing more abundant material.

The above partial outline of the results thus far obtained will be followed in due time by a detailed report on our studies.

Harvey Monroe Hall,
Thomas Harper Goodspeed
Department of Botany,
University of California

SCIENTIFIC EVENTS

BRITISH CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION

The Parliamentary Paper dealing with Class IV. of the Estimates for Civil Services for the year ending March 31, 1919, is summarized in *Nature*. A special grant of £30,000 is included in aid of certain universities, colleges, medical schools, etc., to meet loss of income arising from circumstances of war. It may be remembered that the Estimates for 1915–16 included a similar grant of £145,000 for the same purpose. The grant for the National Physical Laboratory has been transferred from the head of the Royal Society, under which it formerly appeared, to that of the Department of Scientific and Industrial Research. It amounts to £89,750, being an increase of £64,475 upon the grant for 1917–18. The state receives, however, for testing fees and other services rendered by the laboratory the sum of £11,250, and £3,000 as contributions from cooperating bodies. The new Fuel Research Station has a grant of £7,000, of which £4,000 is required for salaries and wages, and £3,000 for apparatus, materials, etc. The grants made by the Department of Scientific and Industrial Research amount to £56,500, in comparison with £30,000 in 1917–18. The salaries, wages and allowances of the department are estimated at £8,900.

The following gives the grants in summary:

United Kingdom and England	£
Board of Education	19,206,705
British Museum	126,142
National Gallery	11,639
National Portrait Gallery	3,779
Wallace Collection	4,012
London Museum	2,300
Imperial War Museum	19,000
Scientific Investigation, etc.	54,241
Department of Scientific and Industrial Research	148,350
Universities and Colleges, Great Britain and Intermediate Education, Wales	321,700
Universities, etc., Special Grants	30,000
Scotland	
Public Education	3,041,545
National Galleries	4,283
Ireland	
Public Education	2,203,104
Intermediate Education (Ireland)	90,000
Endowed Schools Commissioners	855
National Gallery	1,830
Science and Art	163,393
Universities and Colleges	96,350
Total	25,529,228

The appropriations for scientific institutions are as follows:

	£
British Museum	90,022
Natural History Museum	44,045
Imperial War Museum	19,000
Royal Society	6,000
Meteorological Office	22,500
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	500
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Irish Academy of Music	300
Royal Zoological Society of Ireland	500
Royal Hibernian Academy	300
British School of Athens	—
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	3,200
National Museum of Wales	7,500
Solar Physics Observatory	3,000

School of Oriental Studies	4,000
North Sea Fisheries Investigation	—
Royal College of Surgeons in Ireland	500
Edinburgh Observatory	1,691

SCIENTIFIC AND INDUSTRIAL RESEARCH

Grants for investigation and research	56,500
Fuel Research Station	7,000
National Physical Laboratory	89,750

THE AMERICAN MEDICAL ASSOCIATION AND THE WAR

A war conference of secretaries of the constituent State Associations of the American Medical Association was held at the headquarters of the association on April 30. From the *Journal* of the association we learn that the meeting was called to order by Dr. Alexander R. Craig, secretary of the association. Dr. Thomas McDavitt, of St. Paul, chairman of the board of trustees, was elected chairman, and Dr. A. R. Craig, secretary. Dr. McDavitt emphasized the great importance of the meeting. He said the government had made a new call for physicians. There are already in the service, in the different corps, at the present time about 20,000 physicians. The issues involved are so great that the government is anxious to have an excess if possible. The 5,000 physicians that are requested now do not provide for an excess.

Dr. Arthur Dean Bevan, president-elect of the association, spoke of the importance of a survey of every state with a view of recording exactly how many medical men there are in each state, and how many have applied for commissions in the Medical Reserve Corps. This work, he said, can be perfected, as is contemplated and as requested by the Surgeon-General of the Army, by the American Medical Association through its county and state societies.

Dr. Charles Mayo, president of the association, said:

The medical profession was almost the first to become well organized before the war began, because we have had an organization for a long time. So far as the association is concerned, it was easy for organized medicine to get the names of the men we needed to do their bit. In fact, they had been doing their bit by going over to help Britain, France and Serbia in every possible way.

Our profession is organized, but around the outskirts is a great deal of disorganization that has been held over from the methods of the profession in advancing their work in education. In the early period there were in Washington about eighteen bureaus, boards and departments that had to do with medicine. Each of these bureaus and departments spends a great deal of money, and there is absolutely no coordination and no one will let go. Each head wants to be chairman of the committee to look after it. The more we study the question, the more we find that there will be no change until we get a real department of health with an officer in the cabinet to look after it, and then we will have an organization.

A serious problem comes to mind in relation to France. There they have not had any medical schools running for four years. In England the same thing is true. With the natural death rate of doctors and no new degrees granted, it means a great deduction, and the danger that when the schools have started again, there will be lowered standards. I think organized medicine in this country did great service in seeing to it that the government did not in developing draft laws break up the medical schools. I think that has been one of the greatest features shown by organized medicine.

The thing I have been hoping for is that funds may be obtained to develop a great medical teaching institution in Paris. From letters received from the French government, the president and others high in authority, this idea is approved. We could move our men over there a thousand at a time and they could be trained by men at the front who for four years have had at their fingers' ends things that we can not possibly get in this country. I would suggest to turn over now for teaching purposes two thirds to the Americans and one third to France, and after the war make France a present of it, and make Paris the center for American medical study in Europe. It takes a lot of money to run such an institution, but it looks as though the money might be raised. It is estimated that it would take from $100,000 to $150,000 under present circumstances to run such a school for a year. It is most difficult to bring about such a thing under government control. Something like that must be planned by organized medicine, but not by government organized medicine, and turned over to the Surgeon-General for the period of the war. Surgeon-General Gorgas could easily detail

men in the service for temporary duty for the education of these men and give them one month or two months of lectures, and without disorganization we could give our surgeons the absolutely necessary instruction and all around service we have been trying to develop in a more or less haphazard way.

THE INTERALLIED SCIENTIFIC FOOD COMMISSION

At an interallied conference, which was held last November in Paris, it was agreed, according to the *British Medical Journal,* that a Scientific Food Committee should be formed containing two delegates from each of the following countries: Great Britain, France, Italy and America. This committee was to have its permanent seat in Paris, and was to meet periodically in order to examine, from the scientific point of view, the interallied program for food supplies. It was empowered to make any propositions to the allied governments which it thought fit. The delegates appointed from the various countries were: Great Britain: Professor E. H. Starling and Professor T. B. Wood; France: Professor Ch. Richet and Professor E. Gley; Italy: Professor Bottazzi and Professor Pagliani; America: Professor R. H. Chittenden and Professor Graham Lusk. The first meeting of this Commission was held in Paris on March 25, and the following days. At their first sitting the commission was received by M. Victor Boret, minister of agriculture and food. In his opening address M. Boret pointed out that the object of the conference was to study the best means of utilizing the very small food resources at the disposal of the allies so as to effect an equitable distribution of the available food supplies among the allies, having proper regard to the facts of physiology and political economy. He sketched shortly the work of the commission, and his suggestions were embodied later in a series of questions which were adopted by the commission as the problems that would immediately occupy its attention. The commission agreed to establish a permanent central secretariat in Paris, M. Alquier being appointed secretary. In addition to the central secretariat it was agreed that a secretary to the commission should be appointed in each of the allied countries. At its meetings, which lasted till March 29, the commission considered many important questions relating to the minimum food requirements of man, and to the production and distribution of food supplies. The commission will reassemble at intervals, in Paris or in some other of the allied capitals. Professor Gley has stated that it will probably meet next at Rome towards the end of this month.

SCIENTIFIC NOTES AND NEWS

Professor Dugald C. Jackson, of the department of electrical engineering of the Massachusetts Institute of Technology, has been called to France as a major in the Engineer Reserve Corps.

Professor Philip B. Woodworth, dean of electrical engineering of Lewis Institute, Chicago, has entered the government service as a major in the aviation section of the Signal Corps.

Dr. H. E. Wells, professor of chemistry at Washington and Jefferson College, has been commissioned captain in the Chemical Service Section of the National Army.

Dr. George Winchester, professor of physics of Washington and Jefferson College, has been commissioned first lieutenant in the aviation section of the Signal Corps, and is now in France.

Mr. Lawrence Erickson has resigned an instructorship in botany in the New York State College of Agriculture and has enlisted in the Coast Artillery.

Dr. Lewis Knudson, professor of botany in the New York State College of Agriculture, has obtained a leave of absence and is now in Y. M. C. A. work in France.

Calvin H. Crouch, who for seventeen years has been at the head of the mechanical engineering in the University of North Dakota, has accepted a position at Mt. Holyoke, Mass., with the Deane Plant of the Worthington Pump and Machinery Corporation, which is making war material for the government.

J. Ansel Brooks, professor of mechanics and mechanical drawing at Brown University, has

entered the engineering section of the aviation service, and is stationed at Lake Charles, La.

MR. WATSON BAIN, professor of applied chemistry at the University of Toronto, has been granted leave of absence for the duration of the war. He is going to Washington, D. C., where he will be on the staff of the Canadian mission.

E. A. RICHMOND, instructor in physiology at Simmons College, has joined the Signal Corps. At present he is doing research work in physiology at the Medical Research Laboratory in Mineola, N. Y.

DR. WALTER M. MITCHELL, formerly of the astronomical department of the University of Michigan, and recently mechanical engineer with the Midvale Steel Co., Philadelphia, has received an appointment in the Signal Corps, U. S. A. Dr. Mitchell is stationed at Rochester, N. Y., and is placed in charge of the inspection of equipment for the Signal Corps in that district.

DR. A. D. BROKAW, assistant professor of mineralogy and chemical geology at the University of Chicago, has been called to Washington to take charge of the oil production east of the Rocky Mountains.

DR. E. B. SPEAR, professor of chemistry of the Massachusetts Institute of Technology, has been appointed consulting chemist to the Bureau of Mines in connection with the gas warfare work.

P. W. MASON, assistant professor of entomology in Purdue University, has resigned to accept a position in the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C.

R. V. MITCHELL, professor of poultry husbandry at Delaware College, has been granted leave of absence to do work with the U. S. Food Research Laboratory along the line of poultry and egg handling.

DR. C. L. REESE, of E. I. du Pont de Nemours & Co., has been named chairman of the committee on dyestuffs and intermediates of the Chemical Alliance.

DR. CHARLES KEYES, consulting mining engineer and geologist of Des Moines, has been chosen by the Democrats of Iowa for candidate for United States senator, to succeed Senator W. S. Kenyon, whose term expires shortly.

DR. ROYAL S. COPELAND has been appointed by Mayor Hylan to be health commissioner of New York City.

DR. H. E. DUBIN has resigned as chemist to the Montefiore Home and Hospital to accept the appointment of research chemist with the Herman A. Metz Laboratories, Inc., New York City.

AFTER thirty-eight years' service, Mr. Richard Hall has retired from the staff of the geological department of the British Museum.

CAPTAIN ROALD AMUNDSEN proposes to leave Norway this summer in his new Arctic vessel, the *Maud,* which has been specially built for this attempt to reach the North Pole. The vessel is to be provisioned and fitted out for a seven years' stay in the ice, but Captain Amundsen hopes to be back within four years.

PROFESSOR J. H. JEANS, the physicist, has been elected a member of the Athenæum Club for distinction in science.

PHILIP E. EDELMAN, of St. Paul, Minn., has been awarded the Research Corporation fellowship in applied science on competition by a jury consisting of the president of the National Academy of Sciences, the secretary of the Smithsonian Institution, the president of the American Chemical Society, the president of the Research Corporation and the chairman of the Engineering Foundation, upon evidence of scientific attainments, inventions and special fitness for advanced work. Mr. Edelman is an electrical engineering graduate of the University of Minnesota and has served as electrical engineer for radio-communication interests. He is the author of "Experimental Wireless Stations" and other popular technical books, and has since February, 1917, devoted his time principally to research work for the government.

DR. RAYMOND PEARL, of the United States Food Administration, lectured on May 9 at the Washington Academy of Sciences, the subject of the lecture being "Biology and War."

Dr. F. G. Novy, professor of bacteriology and director of the hygienic laboratory, University of Michigan, addressed the Cincinnati Research Society, in the surgical amphitheatre of the Cincinnati General Hospital, on May 1, on "Blood Changes and Anaphylaxis," and on May 2, on "Blood Parasites."

At the meeting of the Chemical Society at London, on April 18, the first of the Hugo Müller lectures was delivered by Sir Henry Miers, whose subject was "The Old and the New Mineralogy."

Girton College, Cambridge, plans to found a fellowship for the encouragement of research in natural science, and especially in botany, as a memorial of Miss Ethel Sargant.

A bronze bust of the late Dr. Daniel Giraud Elliot, mammalogist and ornithologist, is installed on the second floor of the American Museum, in the hall devoted to birds of the world. The bust, which is the work of Mr. Chester Beach, is the gift of Miss Margaret Henderson Elliot, daughter of Dr. Elliot.

Dr. Ephraim Fletcher Ingals, professor of diseases of the chest, throat and nose in the Rush Medical College, Chicago, and active in medical research and organization, died on April 30, aged seventy years.

Dr. Armand Thevenin, of the Sorbonne, known for his work in paleontology, died on March 7, aged forty-eight years. He had been experimenting with poisonous gases and in the course of his work contracted the illness which proved fatal.

Mr. W. Hague Harrington, one of the best known of the older Canadian entomologists, died on March 13 at Ottawa, Canada, at the age of sixty-six years. Mr. Harrington was born in Novia Scotia, and entered the federal civil service at Ottawa in November, 1870, eventually reaching the rank of superintendent of the Savings Bank Branch. He was one of the founders of the Ottawa Field Naturalists' Club, and at one time was president of the Entomological Society of Ontario. In 1894, he was elected a fellow of the Royal Society of Canada. For many years his main interest in life was entomology, and he brought together a large collection of Canadian Coleoptera and Hymenoptera. He was a systematist of recognized standing, and was probably the highest authority on Hymenoptera in the Dominion of Canada. He was a striking example of that class of men who have done pioneer work in natural history in Canada and the United States, while pursuing this work as a hobby rather than as a vocation.

UNIVERSITY AND EDUCATIONAL NEWS

The Kentucky legislature in the session ending on March 15 made a notable change in the laws providing for the support of institutions of higher education. In view of the material increase in the state's property assessment by the tax commission the legislature passed the reapportionment tax bill and gave the university a rate of 1¾ cents on each hundred dollars of the assessment. This provision will give the university an increase of $200,000 annually over the income it has had in previous years. Plans are now under way for a material increase in the teaching staff and the undertaking of extensive repairs in the plant of the university. Olmstead Brothers, of Brookline, Mass., have been employed to work out plans for campus improvements. Due to war conditions, no new buildings will be constructed at present. President McVey, formerly of the University of North Dakota, began his service with the University of Kentucky last September.

Announcement is made of the completion of the diamond jubilee fund of $800,000 for the Ohio Wesleyan University.

A new chemistry building is to be erected on the campus of the University of North Dakota. The ground has already been broken and contracts for the construction of the building have been let by the State Board of Regents, at a cost of $62,483.

At a recent meeting of the council of the University College of Wales, Aberystwyth, it was reported that an anonymous donor was prepared to transfer the sum of £10,500 to the college for the purpose of endowing a chair in geography and anthropology. Herbert John

Fleure, who was appointed professor of zoology at the college ten years ago, will now devote all his energies to the department of geography.

DR. R. H. JESSE, JR., head of the department of chemistry at the Montana State University at Missoula, has been appointed dean of men for the institution.

DISCUSSION AND CORRESPONDENCE

ASTIGMATISM AND COMA

PERHAPS the clearest statement of the prevailing theoretical distinction between the five spherical aberrations is that given in the last edition of the Encyclopedia Britannica by Dr. Eppenstein of the Zeiss factory.

The differentiation there made between astigmatism and coma is not, however, in strict conformity with the facts. The term "astigmatism" as applied to lenses has always referred to the increasing lack of sharpness in the image towards the edge of the field in an uncorrected or poorly corrected lens system and "coma" to the peculiar radial flare sometimes very evident in the outer portions of the field.

The explanation given in the article just referred to is that astigmatism is the aberration due to obliquity and is therefore fully shown by very narrow bundles of rays, while coma can not be shown at all except with a wide bundle.

This explanation is the result of reasoning from the theory of astigmatism devised by Sturm, who assumed a behavior of oblique rays completely at variance with the facts. By the use of a method developed by the writer it is possible to calculate with strict accuracy the path and focal point of any ray through a lens surface from any point of the field by the use of which it became at once evident that the two foci calculated by Sturm's method locating the position of the two astigmatic surfaces are pure fictions, though this calculation is nevertheless a rough numerical approximation of this aberration. The detail of the new method of calculation will be presented elsewhere.

As a matter of fact only distortion and curvature are independent of the bundle width, and both coma and astigmatism are increased with increase in the width of the ray bundles, and it is not true, as stated in this article, that coma alone is the result of the width of the ray bundle. This can be very easily proven without recourse to mathematical calculations by the use of a poorly corrected photographic lens, examining the images on the ground glass or making photographs of a grating, using a wide and a narrow stop.

The best known test for astigmatism is the fact that where this aberration is uncorrected one of two crossing lines may be very vague, while the other is sharp and distinct. This is best seen with the wide stop. The effect is usually explained according to the Sturm theory by saying that only one of these lines can be in focus at a time and that either may be brought into focus. If one will shift the ground glass he can easily prove that only radial lines can be sharply focused by an uncorrected lens, and that towards the edge of the field lines at right angles to these radial lines can not be brought into focus at all and are in fact most nearly in focus on the same plane as the radial lines.

When the grating is rotated 90° the lines that were vague may become sharp but only when a line is approximately radial is the effect of astigmatism nullified.

Both astigmatism and coma consist in a longitudinal spreading out of the image produced by the zones of the lens. The radial lines remain sharp because the shifting is radial and the shifted images of a radial line are superimposed, the line remaining sharp because its width is not increased to an appreciable extent.

Instead therefore of making the distinction expressed by Dr. Eppenstein that the features of lateral aberration due to obliquity constitute astigmatism, and that those dependent on difference of zones produce coma, the writer would suggest that the former be defined as the difference of focus produced by the median region of the lens and that of the most distant marginal point while the latter represents the focal difference of the nearest marginal point of the lens.

The reasons for these new suggestions are: (1) That the sharpest focus is normally produced by the central portion of the lens and lateral aberrations depend on differences of focus that may result from the passage of light rays through a marginal region of the lens; (2) that the best measure of lateral aberrations are the extreme deviations, and these are those of a point at the edge of the object field through the nearest and through the most distant marginal point of the lens; (3) that the greatest difference of focus of a lateral object between the central image and that produced through an edge point is the one produced by the most distant point on the lens surface and therefore this may most appropriately be designated astigmatism; (4) that the focus through the nearest marginal point of the lens may lie on either side of the median focus and if on the same side as that of the distant marginal point there is produced the characteristic optical effect called coma, and finally (5) that these two measurements are strictly comparable with the measurement always made to determine the longitudinal aberration of the axial rays and are therefore the only consistent methods of determining the two lateral aberrations.

C. W. Woodworth

University of California

OBSERVATIONS ON THE AURORAL CONVERGENT, APRIL 5, 1918

An auroral display of more than usual interest occurred on Friday evening, April 5, 1918, and was observed by the writer from a point about one and a half miles southeast of the Dominion Observatory, Ottawa.

At about 10.30 P.M. the rays seemed to be converging at a more or less well-defined point approximately half way between Saturn and the "Big Dipper." For all that the writer knew the position or path of the point of auroral convergence and its height above the earth's surface had been subject to such frequent observation that any measurements he might make on this particular evening would be superfluous, but they seemed to him more worthy of record for a scientific magazine than the random descriptions of color, play of light and duration which have recently appeared and he decided to see whether or not the position of the point of convergence could be determined with any degree of accuracy.

Exact Western Union time was obtained from "central," but the rough nature of the observations makes the times recorded below approximate only, say within one minute, the fact that they are recorded as 11.20 and 11.40 being due not to rough estimation but to choice. The writer used a clothes reel with taut wires, revolving it so that one of the wires intersected both Saturn and the point of convergence. Three small markers ($\frac{1}{2}$ inch wide) were hung on the wire and moved about until they covered Saturn, the point of convergence (convergent), and another known point or star, all in line.

The following observations were made:

10.55 P.M. Saturn, convergent, and Mizar in line.

Saturn to convergent : convergent to Mizar :: $11\frac{3}{4}$: $10\frac{1}{2}$.

11.20 P.M. Saturn, convergent, and star at end of handle of "Big Dipper" in line.

Saturn to convergent : convergent to star :: $11\frac{7}{8}$: $8\frac{5}{8}$

11.40 P.M. Saturn, convergent, and point in sky on line from Mizar through end of "Big Dipper" handle and the barest fraction (say one sixth) farther from the end of the handle than that is from Mizar, all in line.

Saturn to convergent : convergent to point :: $13\frac{1}{2}$: 7

11.55 P.M. Saturn, convergent, and Gamma of Bootes in line.

Saturn to convergent : convergent to Gamma :: $15\frac{1}{2}$: $7\frac{1}{2}$

For the last observation (11.55 P.M.) the rays of light had become faint enough to make the exact position of the convergent somewhat doubtful and measurements were discontinued. In fact the latter observation was taken at 11.55 instead of at midnight, which would have preserved the 20-minute interval, because of a fear that the position of the convergent would become too indistinct for observation.

There was a perceptible tendency for the

light near the convergent to arrange itself in the form of an hyperbola, but no definiteness in the position of the axes could be detected other than a tendency for the visible hyperbola to occupy a quadrant opening toward the north or northeast. At many times during the hour the auroral display covered large sections of the southern sky, and the writer can remember thinking of the peculiar lateral shifting of the curtain in certain auroras and wondering how this would look if it took place near the convergent, but saw no such movement. At times a shaft of light more or less meridional in direction lay across the convergent.

At the time the writer hoped that others were making similar observations and that it might be possible to determine the height of the point of convergence and he was somewhat surprised later to realize that his observations indicated the further fact of a change in the position of the convergent with reference to the stars which seemed only partly to be explained by their rotation. He only hopes that similar observations were made by others in different places and that the ones herein recorded are sufficiently accurate to make them of value. They at least have the merit of having been made by one who had no preconceived idea of what they might indicate, and who regrets, if they prove to have value, that he was unable to make use of more exact tools.

LANCASTER D. BURLING

GEOLOGICAL SURVEY,
OTTAWA, CANADA

THE DOMESTICATION OF THE LLAMA

TO THE EDITOR OF SCIENCE: A note in SCIENCE for March 15, 1918, by Mr. Philip Ainsworth Means, leads the reader to believe that the llama, alpaca, vicuña, and guanaco are distinct species and that the common belief is that all have been domesticated to some degree.

Prior to about 1890 there was great confusion regarding the specific status of these four animals, though the prevailing theory was that the llama had been derived from the guanaco and the alpaca from the vicuña. It is now known that the vicuña has never been domesticated, and that the alpaca and the llama are both domesticated forms of the wild guanaco.[1] In view of the conspicuous differences between these two tame races of the guanaco it is easy to believe that a very long period of actual domestication has obtained, for the alpaca has been bred for his wool and the llama has been developed as a beast of burden as effectually as any of our races of domestic animals have been produced for special purposes by the most careful selective breeding.

The llama and the alpaca are not known in a wild state, though they of course occur, as do almost all other domesticated species, in a semi-wild or feral condition. They represent one of the rare cases of true domestication of an animal, and one of the still rarer cases where the ancestral species is known and still exists as a wild creature. Contrary to the statement in SCIENCE, they do breed freely in confinement; but since so many wild animals propagate regularly in captivity this can hardly be considered a test of true domestication.

N. HOLLISTER

NATIONAL ZOOLOGICAL PARK,
WASHINGTON, D. C.,

THE AUDIBILITY OF SOUND

REPLYING to the suggestion of Mr. Willard J. Fisher, in your issue of April 26, that an investigation be made of the area about Halifax with regard to audibility of the sound from the great explosion there, it may interest you to know that such an investigation was undertaken by the National Geographic Society not long after the occurrence of the explosion and that a quantity of data has been accumulated which is to be charted and tabulated as soon as other work will permit.

CHARLES E. MUNROE

SCIENTIFIC BOOKS

The American Indian. An Introduction to the Anthropology of the New World. By CLARK WISSLER, Curator of Anthropology in the American Museum of Natural History, New York City. New York, 1917. Pp. xiii, 435.

[1] Thomas, *Proc. Zool. Soc. London*, 1891, pp. 385–387.

It is now nearly thirty years since the appearance of Brinton's "American Race." Primarily an attempt at a linguistic classification, especially of the South American tribes, this volume gives in a very summary form a general survey of all the peoples of the New World. The generation which has elapsed since then has been extraordinarily prolific in the accumulation of new data, but until the publication of Dr. Wissler's volume, no serious attempt had been made either to gather together and correlate this great mass of new material, or to give a really adequate account of the peoples of America and their culture. The debt, therefore, which not only anthropologists but all who are in any way interested in the aborigines of the New World, owe to the author is great, for not only has he judiciously summarized and correlated the results of a host of special investigators, but he has drawn from these results general conclusions of wide importance, which gain greatly in their force by the careful consideration shown for the form and order of the presentation and discussion of the material.

The first thirteen chapters are given to a consideration of the major facts of the culture of the Indian throughout both continents. Beginning with the material culture, the fine arts, social grouping and regulations, ritualistic observances and mythology are treated in order. On the basis of these facts, the peoples of the two continents are grouped in fifteen culture areas, whose limits and characteristics are defined. Next the archeological data are summarized, with the result that twenty-four typical areas are recognized. Archeology having introduced the time element, such evidence as exists on the chronology of American cultures is presented, both dependent on stratigraphic as well as actual historic data. The linguistic and somatic characteristics and classifications are next passed in review, and the broad foundation thus completed for the suggestive and stimulating final three chapters. In the first of these the separate results of the classification on cultural, linguistic and somatic data are correlated, and the influences and importance of migration and of environment are discussed. In the second, the larger questions of culture origins and of the association of culture traits are considered, with the resulting conclusion that culture must be studied and explained from the historical standpoint rather than the biological, which is here not applicable. Finally, in the concluding chapter, the ultimate questions of the origin and relationships of American culture and of the American peoples are outlined. Here the case for the virtual independence and purely local origin of New World culture is clearly and convincingly stated, although from the physical standpoint, the ultimate Asiatic origin of the Indian is demonstrated with equal force. In an appendix useful tables of linguistic stocks are given, bringing together for the first time in handy compass, the material for both continents. A selected bibliography, mainly of the more recent authorities, closes the volume.

It would be of little value to attempt to summarize in the space available, the great mass of material in the book; one can only point out a few of the more important general conclusions reached. One of these is this, that in the domain of material culture, the higher developments were nearly all concentrated in the area of intensive agriculture, and that it is probable that these higher cultural elements spread not singly, but often in association, *e. g.*, that the knowledge of and the making of pottery and textiles, spread with the use of agriculture. On the social side, the fundamental unity of type is pointed out, and evidence brought forward to show that clan organization, dual grouping, age-grades, secret societies and the totemic complex are not necessary stages in the evolution of society, but rather local developments, based on special conditions. This fundamental unity of the peoples of America and the independence of their culture is emphasized in many ways, and the point well made that all the varied attempts to derive the whole or portions of this culture from Asiatic or Polynesian sources, overlook the chrono-

logical factor, which in this case can be shown to be decisive. Perhaps the most suggestive portion of the volume is at the end, where Dr. Wissler brings out the ultimate common derivation of the American peoples and those of the great Mongoloid group in Asia. Summed up, his conclusions are that a detachment of the parent Mongoloid group came into America at a time when man had barely attained the stage of making polished stone implements. This period was not necessarily contemporaneous with the same development in Europe, for it may well have been even earlier. After this detached portion of the group had spread into the New World, climatic changes cut off the connection, and forced both the parent and the derived group toward the south. In the Old World, contact with other differentiated groups gave to the Asiatic branch culture stimuli; in the New World these were lacking, and the people developed in isolation. In the New World the rate of progress along the culture road was thus slower than in the Old, and we may well ask what another thousand years of uninterrupted growth would have produced.

Throughout the volume effective use is made of maps showing the distribution of the various features under discussion. If criticism were to be made of these, it would be in regard to the use of rigid rectilinear boundaries. In spite of the author's justification of this method on p. 242, it would seem that his purposes could have been equally attained by a little more adherence to the actual facts. It is also rather aggravating to find several cases where the map and the text do not agree. Thus on p. 59 it is said that the loom was probably developed in the area of intensive maize culture, and "from there it was diffused around the north coast of South America and down the east side," yet in the map, Fig. 20, there is no indication of its extension beyond western Venezuela. The plates and illustrations are in general excellent, but one may question the wisdom of reproducing the crude woodcuts from Wood's antiquated volumes, when more modern sources are available.

In dealing with so large a body of evidence, it is inevitable that many controversial points should be touched upon, and reference to a few of these may be made. There are also a few cases of apparent contradiction, and some errors of statement. Thus in the chapter on food areas, the squash is said (p. 18) to be cultivated in the northern half of the eastern maize area, whereas in the list of "Plants Cultivated by the Natives of the New World before 1492" (p. 20) the area of cultivation is given as "tropical America." Again, on p. 12, the original inhabitants of the Guanaco Area are said to have used the lasso in hunting, although later (p. 35) this instrument is declared to have been invented only after the introduction of the horse by Europeans. In showing the distribution of tailored garments (Fig. 23) it is somewhat doubtful whether the areas occupied by the Montagnais and Nascopie in Labrador, and by the Micmac in the Maritime Provinces, should be included. In Fig. 24, showing the distribution of types of footwear, the considerable use of the sandal in the southeastern states is not indicated. On p. 111 in describing the houses of the Californians, a somewhat incorrect impression is given, for the large and solidly built semi-subterranean, earth-covered lodges which were typical of much of the Central Californian region, are not referred to. In discussing the distribution of the grooved axe, its occurrence in South America is said to be limited to Ecuador, whereas it occurs outside this region, from northwest Argentina to Guiana.

In Chapter XIV., in discussing the several culture areas, Dr. Wissler is right in saying that the Eastern Woodland Area is one of which the "characterization is difficult." Granting this, it seems somewhat dubious to select the Central Algonkin group as the type, for if the northern is to be thrown out because of its similarities to the Mackenzie Area, the Iroquois and the Eastern because of southern influence, this geographically smallest portion lying southwest of the Great Lakes is equally disqualified by this same

southern influence as well as that of the Plains. The fact is, that the convenient lumping together of all the tribes of the northeast of the continent in one area can hardly be justified, and this region, territorially great and culturally quite varied, must be split up if we are to keep true to the facts. A similar difficulty arises in the attempt to bring all the peoples of the southern tip of South America together in one area. This involves the collocation of such different types as the Yaghan and Alikaluf, with the Araucanian and Guycuru, tribes which had little or nothing in common except the fact that they were non-agricultural.

Similar questions may well be raised in regard to Archeology. Thus it is not clear why the extreme southwest corner of the North Atlantic Area should be taken as the type for the whole region, when a large proportion of the characteristic elements given are demonstrably even more typical of the areas to the west and south. The map (Fig. 76) again, does not agree with the text in the limits given to the South Atlantic Area. The discussion of the Mississippi-Ohio Area is quite inadequate, as no attempt is made to give an idea of the more characteristic and peculiar types of mounds and earthworks in the Ohio Valley. In areas XIX. and XX. no mention whatever is made of the very abundant and characteristic well and chambered graves, whose importance in relation to cultures north and south is considerable, and which constitute perhaps the most striking single feature of this whole region.

In the chapter on linguistic classification, it is most unfortunate that a number of serious errors have crept into the map, Fig. 87, reproduced from that of Chamberlain, whose initials are incorrectly given. In Dr. Wissler's map five stocks given in his list are entirely omitted, viz., the Corabecan, Curacanecan, Mainan, Puquinan, and Sanavironan; the following stocks are wrongly placed, No. 55, Ocoronan should be 65, Puquinan; No. 33, Enimagan should be 32, Curucanecan; No. 15, Canichanan should be 55, Ocoronan; No. 18 Caririan (in Northern Bolivia only) should be 15, Canichanan. Errors of this sort seem rather inexcusable, when the map is merely a direct copy of Chamberlain's original.

In Chapter XIX., in speaking of the "migration factor," the author makes statements for which it seems difficult to give any justification. He says (p. 335) "migration is exceptional" and that when migrations do occur, "they all . . . are circumscribed movements in a single area." To speak of migratory movements extending over thousands of miles, as in the case of the Eskimo, Athabascan, Tupi, Arawak, Carib, etc., as "circumscribed" is in itself rather staggering, but to declare that such movements of peoples were confined to a "single area" is simply a gross mis-statement of fact. If by "area" is meant "culture area," the cases of tribal movement from one to another are too numerous and too well known to need mention; if, as the remainder of the paragraph seems to indicate, Dr. Wissler means by "areas," regions of similar environment, the instances of transgression of these bounds by migrating tribes are still numerous. To take but a single case: just how does the author propose to make the known distribution of the Siouan tribes fit with his statement? Certainly the Biloxi of the sub-tropical Gulf coast, the Totero, Sara and Monacans of the Alleghanies of Virginia and North Carolina, the Crow of Montana and the Winnebago of Wisconsin can hardly be said to have been living in a "single area"!

A last word of criticism may perhaps be allowed in regard to the map at the end of the volume, showing the location of the more important North American tribes. There is no statement anywhere as to the date or period represented, but it is to be assumed that the intention was to show the locations at the time of the first European contact. If so, the map contains numerous errors. Thus the Ojibwa are shown far out in the plains west of Lake Winnipeg, while the Cree are extended almost to the base of the Rocky Mountains. These positions are certainly not those given by the earliest accounts which we have of these tribes, which are there con-

sistently placed much further to the east, and entirely outside the plains. One must also ask on what authority the Kickapoo are placed in southern Indiana, the Timuquana in southern Florida, the Arikara to the north of the Mandan, the Shasta in northeastern California and Nevada, the Quinaielt on the Oregon coast and the Tillamook in the Willamette Valley? These locations, so totally at variance with the accepted positions of these tribes, can only be due to carelessness in preparing the map, or to quite revolutionary new data which have come into Dr. Wissler's possession. Of the misprints noted, the following are the most important: p. 45, asolepias for asclepias, apocy*rum* for apocy*num*; p. 104, roo*ms* for roo*fs*; p. 182, Guat*o*vita for Guat*a*vita; p. 229, Ch*a*pon*e*c for Ch*ia*p*a*nec; p. 273, north*east* for north*west;* p. 292, Hokan for Penutian; p. 231, Lecan for Changoan.

The great excellence and value of Dr. Wissler's book, however, must not be thought to be impugned by these stray criticisms. He has accomplished a difficult task with conspicuous success, has drawn for us the first adequate picture of the aborigines of the whole of America, and has given us a volume to which specialist and layman alike may turn with confidence that they will find in it the latest results of study in this field, admirably arranged and clearly stated. To all who are in any way interested in the original Americans, the book will be indispensable.

R. B. DIXON

HARVARD UNIVERSITY,
CAMBRIDGE, MASS.

SPECIAL ARTICLES

MASS MUTATION IN ZEA MAYS

THE principle of mass mutation, proposed by Bartlett on the ground of his researches on *Œnothera Reynoldsii* and *O. pratincola,* seems to me to be one of the most fertile discoveries made in the experimental study of the origin of new characters. In *O. Reynoldsii* the two first artificial generations were almost uniform, but in the third a splitting occurred, producing about 40 and 28 per cent. of two new types, which were called *semiata* and *debilis.* In *O. pratincola,* which in a number of strains is constant with some stray mutations, one strain produced in the third generation four different types, called *formosa, albicans, revoluta* and *stricta.* The total percentage of these amounted to about 75 per cent.

In order to explain this sudden appearance in such large numbers Bartlett assumes that the fundamental mutation occurred in only one of the two gametes in a generation preceding the one in which the diversity became manifest. In the next generation it was masked by the dominance of the character transmitted through the other gamete. Segregation then occurs in the following generation and it bears a certain degree of resemblance to Mendelian segregation. But whereas the law of Mendel applies to hybrids between different species, varieties or races, here the splitting occurs within a single experimental pure line. The law of probability holds good for both cases, but the starting points are different. Mutational segregation is directly concerned with the origin of a new character, but Mendelian segregation assumes the preexistence of all unit-characters involved. It should be remarked, however, that mass mutation is not necessarily limited to such cases, but may prove afterwards to embrace other types also.

It is now generally conceded that mutations take place ordinarily in the production of the sexual cells, some time before fecundation, probably at the time of synapsis. From this conception the conclusion directly follows that the copulation of two similarly mutated gametes must be rather rare. Far more frequent must be the instances in which a mutated sexual cell combines with a normal one. The first-named cases produced the full mutations, and the types with a doubled number of chromosomes, called *gigas,* are the clearest instances. Such forms have occurred in *Œnothera Lamarckiana, O. stenomeres, O. pratincola, O. grandiflora* and others. The individuals, due to the combination of mutated with non-mutated gametes may be called half mu-

tants. In nature, where, as a rule, mutations are very rare, the chance for the occurrence of full mutations is mostly too small, and stray novelties, found in the field, must generally have originated in the indirect way of half mutants followed by mass mutation. This would, at the same time, explain why they are so often met with in two or more individuals.

Half mutants may differ externally from the strain, which produced them, as *e. g.*, in the case of *Œnothera rubrinervis*, or may fail to show such visible marks, as in that of *O. Lamarckiana gigas mut. nanella*. In both cases they will give rise to the full mutant in relatively large numbers in the second generation. The full mutant of the first instance is designated as *O. mut. deserens*, and that of the second is represented by dwarfs with the flowers, foliage and nuclei of *O. gigas*. They occur in about 20–30 and 15–18 per cent. among the offspring of the original half mutants.

In a strain of ordinary corn, which I cultivated for other purposes, an instance of mass mutation has occurred which evidently requires the same principle for its explanation. The mutants have been described under the name of *Zea Mays sterilis* and figured in Vol. I. of the *Botanisch Jaarboek* of the Society Dodonæa at Ghent in Belgium. They are devoid of all branches. No lateral stems, no ears, no ramifications of the spike and no male flowers are produced. The whole plant is a barren stem with a naked spill instead of an inflorescence. They are built in the same manner as the unbranched fir, *Pinus Abies aclada*, described and figured by *Schröter*.

I cultivated my strain after a simple method, sowing each year the seeds of a single ear, planting the seedlings on sufficient distances to insure a high degree of self-fertilization and eliminating the individuals produced by stray crosses by means of vigorous selection. No unbranched specimens occurred during the six first years. In the seventh generation, however, they appeared unexpectedly and in 40 specimens among 340. This indicated a percentage of 12, which is far higher than the ordinary mutability in *Linaria, Chrysanthemum, Œnothera* a. o. (mostly 1–2 per cent.). Besides these unbranched plants some intermediate forms were seen, with incompletely developed ears and spikes. I chose one of these for the continuation of the race and had, next year, a generation of 57 individuals eleven of which belonged to the new type. The percentage figure was 19, giving new proof of the occurrence of mass mutation.

If we assume a sexual cell of the fifth generation to have mutated into the unbranched character, and to have combined with a normal one, the sixth generation may have included a half mutant of the new type, which could not be discerned at the time, since it was wholly unexpected, but was chosen by chance. Segregating after the principle of Bartlett it could have produced 25 per cent. of sterile individuals, besides 50 per cent. of half mutants with more or less incomplete ramification. These would repeat the splitting in the following generations. Had I known that principle at the time, I would surely not have given up the culture, as I did.

In the production of other sterile varieties the principle of mass mutation must have played a similar rôle. They can not evolve through the slow accumulation of small useful deviations, and their chance of arising at once as full mutants must be very little. Double flowers of the petalomanous type are well-known instances. I once found such a mutation of *Ranunculus arvensis* in a meadow, and the corresponding variety of *Caltha palustris* is cultivated in gardens, where it propagated in the vegetative way.

Yellow seedlings, which die after unfolding their seed-leaves, are another instance, and for these the mutational percentages are easily ascertained. They are often high enough to give proof of the presence of mass mutation. I found 25 per cent. for *Linaria vulgaris*, 15–30 per cent. for *Papaver Rhœas*, 10–15 per cent. for *Scrophularia nodosa*, 9–13 per cent. for *Clarkia pulchella* and about 10 per cent. in some other instances.

Mass mutation must be quite common in

nature. It is probably the ordinary way in which white-flowered, hairless and spineless varieties and so many analogous novelties are produced in the field and in horticulture. The experimental instances seem quite sufficient and broad enough to establish the principle, but as yet they belong almost to the retrogressive mutations. The claim that progressive changes are also due to sudden mutations still mainly rests on our theoretical conception of the evolution of organic life in general. But, fortunately, some experimental evidence is coming in of late for this point also.

HUGO DE VRIES

LUNTEREN, HOLLAND

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

THE sixty-ninth meeting of Section E (Geology and Geography) of the American Association for the Advancement of Science was held in the auditorium of the new U. S. Bureau of Mines Building in Pittsburgh, Pa., on December 28 and 29. Professor George H. Perkins, vice-president of Section E, presided.

The general program, of which abstracts follow, was so full that each session far overran the usual time limit. Geological workers from the general Pittsburgh region contributed much to the success of the meetings.

The address of the retiring vice-president, Professor Rollin D. Salisbury, of the University of Chicago, upon the subject, "The educational value of geology," was given on the afternoon of December 28, and was printed in SCIENCE, April 5.

On the morning of December 29, a symposium entitled "Mineral resources and chemical industry" was held jointly with Section C. This was essentially a war-time session dealing with the peculiar problems now facing this country as the result of the war, the unusual demand for certain materials and products, and the necessity of relying upon the country's own reserves and industries for various materials formerly imported in large measure from sources not now available. The papers upon mineral resources described in detail the special efforts now being made by the U. S. Geological Survey and the U. S. Bureau of Mines to solve the problem of supplying the country with the necessary fuels, potash salts and metals (such as tungsten, chromium, nickel, cobalt, vanadium, manganese, etc.) which are required for the successful prosecution of the war. The papers on chemical industries portrayed some of the efforts put forth by the chemists in response to certain urgent needs and special situations developed by war conditions.

The Symposium comprised the following papers:

1. Introduction to the discussion of our mineral reserves under war conditions: David White.
2. Coal, coke and tar distillation: S. W. Parr.
3. The bearing of the oil industry on the war: C. H. Beal.
4. Glassware, with special reference to chemical glassware: S. R. Scholes.
5. Potash production in the United States: W. B. Hicks.
6. Research in chemistry and metallurgy as applied to non-ferrous metals: C. H. Fulton.
7. Domestic resources of ferro-alloy ores: D. F. Hewett.

These papers will be published in another number of SCIENCE.

Dr. David White, of the U. S. Geological Survey, was elected vice-president of the association and chairman of Section E for the coming year; Dr. Wallace W. Atwood, of Harvard University, member of the council; Dr. George F. Kunz, of New York, member of the General Committee; Dr. George F. Kay, of the University of Iowa, member of the sectional committee to serve one year in place of Dr. David White, resigned, and Dr. L. C. Glenn, of Vanderbilt University, member of the sectional committee for five years. To represent Section E at the celebration in honor of the one hundred and seventy-fifth anniversary of the birth of Abbé René Just Haüy, to be held at the American Museum of Natural History, New York City, on February 28, 1918, there were appointed by the chairman Dr. E. C. Hovey, Dr. C. P. Berkey and Dr. J. E. Woodman.

The titles and abstracts of the papers of the general program follow:

Glass sands: CHAS. R. FETTKE (will be printed in SCIENCE).

The Saltsburg sandstone as a building stone: S. B. BROWN.

The rapidity with which the Saltsburg sandstone gained favor may be seen from the number of important structures in which it has been used during the last six years. A few of these are the following: The Cabin John bridge at Washington City, some interior work in the Grand Central Rail-

road Station, New York City, the Russell Sage Memorial Building, the synod house of the Cathedral of St. John the Divine, the interior finishing of the Jersey City postoffice. It has been used also in the new postoffices at Morgantown, Grafton and Sistersville, and in the Presbyterian Church at Fairmont, West Virginia. It has been used in the United States Aluminum Clubhouse at New Kensington, Pennsylvania; in the W. W. Willock residence at Sewickley, the Inslie Blair residence at Tuxedo, and in the finely finished Stewart Duncan residence at Newport, Rhode Island. This last has been described as one of the masterpieces of American architecture. A still more artistic use to which it has been put is in the case of the elaborate mantels at the New Kensington Clubhouse and also the mantel in the Mulligan residence in Pittsburgh. The artistic carving and the statues on the Schwab estate, and the buffaloes and the Indian heads on the Cabin John bridge show some of the finer uses to which it lends itself. This would indicate that a new building stone of singular beauty has caught the favor of the public for refined uses, and its future popularity may be predicted with some degree of confidence. Its strength is sufficient for any purpose to which it is likely to be put, tests showing a crushing strength of 9,000 to 11,000 pounds to the square inch having been made. Its chemical composition runs thus: Silica, 96.50 per cent.; ferric iron, 1.76 per cent.; alumina, .86 per cent.; lime, .35 per cent.; magnesia, .02 per cent. It would therefore be graded as a sandstone of moderate purity with its iron cement very evenly distributed through it. Professor Stevenson probably never saw the localities of its best development, but the success of this stone forty years after reminds us of his statement, in which he calls it "a magnificent rock, in layers ten to fifteen feet thick, most of which are of excellent quality and would prove a durable building stone." Although he could hardly have foreseen the finer uses to which the Saltsburg sandstone has been put, nevertheless Professor Stevenson was a true prophet, as every geologist must be who writes only the truth.

The compilation of coals: Reinhardt Thiessen.

A complete and correct explanation of the meaning of the bright or glanz and dull coal, and an interpretation of the lamination of coal in general has never been given. In spite of many theories and attempts at explanations the matter is still in a state of confusion. Extensive studies have shown that the bright or glanz coal consists invariably of components derived from matter that at one time were larger fragments or parts of woody parts of plants, such as parts of logs, stems, branches and roots. These correspond in every respect to the parts of logs, branches and roots in peat. The dull coal represents a general débris of plant substances, and consists primarily of components derived from fragmentary parts, or chips of the woody parts of plants, and fragmentary matter derived from various other parts and organs of plants, embedded in or cemented together by an attritus, together forming the embedding medium of the larger components or bright coal. The attritus consists of what at one time was very finely macerated plant matter and corresponds in every respect to the fine "mud" in peat. The components derived from the fragmentary woody parts of plants are generally very thin and scale-like and owe their peculiar shape and form to a mode of disintegration through lesions along the annual growth rings, and along the rays, caused by a differential decay during the peat stage. This phenomenon finds an exact counterpart in recent peat.

The travertine deposits of the Arbuckle Mountains, Oklahoma, with reference to the plant agencies concerned in their formation: W. H. Emig.

At the present time there is a continuous development of travertine on the numerous falls along two parallel streams in the Arbuckle Mountains, namely Honey Creek and Falls Creek. The development of the travertine falls is due in part to the presence of felt-like masses of algæ—species of *Œdogonium* and *Vaucheria*, also *Oscillatoria* and *Lyngbya*—and in part to the presence of aggregated tufts of the water mosses, *Philonotis calcares* and *Didymodon tophaceus*. The various types of travertine, formed as a result of the continuous growth of certain plants in the calcareous water, are quite characteristic. The similarity in the microscopic structure of recent and older deposits of travertine is very striking. A comparison of the newly formed deposits with the oldest travertine of the Arbuckle Region indicates that the same plant agencies were concerned in the construction of all the travertine formations in Oklahoma.

The Kanawha black flint and other cherts of West Virginia: W. Armstrong Price.

Ten Paleozoic formations contain deposits of chert (or flint). The cherts are found in silicious and magnesian members of limestones and calcareous shales. Limestone-bearing formations ap-

parently barren in chert are: the Silurian formations, and limestones in the upper portion of the Pennsylvanian. The Greenbrier limestone is notably poor in flint. The Kanawha Black Flint occurs in two lithologic phrases—a high-silica, low-alumina, compact phase, and a phase slightly lower in silica and higher in alumina which has a "slaty" structure. Fossils of species which possess lime shells have been leached out before the deposition of the silica. Replacement of calcium carbonate has played an unimportant rôle in the formation of the flint. Depositions of silica by descending surface waters in the pores of a carbonaceous and highly silicious rock has resulted in the formation of a dull, black, compact chert or flint. Absence of original silicious ooze is inferred but not proven. Tilting of the strata has enabled solutions to migrate along the dip, increasing silification. The black flints of the Pennsylvanian were used by the Indians in the manufacture of arrow heads and implements. They have been scattered over many counties beyond the flint outcrop. Flint from limestone formations often contains sufficient lime to form a compact surface when used in road building. Chert beds in limestone valleys form ridges upon which apples and berries grow especially well.

The determination of the stratigraphic position of coal seams by means of their spore-exines: REINHARDT THIESSEN.

There has thus far been found no index by means of which coal from different mines or from different bore holes may be correlated, or by means of which the position of a seam may be determined. The spore-exines in coal promise to furnish such an index. The coal from every seam, thus far examined, contains one or more types of exines that are characteristic or predominant or both of each bed, by means of which the coal may readily be identified and the position of its bed be determined. Spore-exines are very prominent in coal, are easily recognized and have retained all their original characters by means of which each type may easily be defined. The coal of the Pittsburgh seam contains at least one type of exine that is both predominant and characteristic of that seam. Similarly the coals from Sipsey, Alabama, Black Creek bed; Carbon Hill, Alabama, Jugger bed; Shelbyville, Ill., bed No. 2, and from Buxton, Ia. Each contains at least one type that is both the predominant and the characteristic exine. Some of these have, besides these, at least one other type that is characteristic of the seam, although not the predominant one. Bed No. 6, of Illinois, contains at least one type that is characteristic of that bed, and probably more.

The Holmesville, Ohio, glacial terrace and moraine: G. G. COLE.

The village is situated on a large terrace surrounded on all sides by low ground, with a swamp separating it from the recessional moraine half a mile south. The terrace is very steep on the north and while quite flat slopes gradually to the south. Well-washed coarse gravel is found on the northwest higher corner, the southern being fine material and sand. A peculiar arrangement occurs in the terrace: gravel of 74 per cent. local origin at the top, a belt of large boulders at a mean depth of 8 feet, mostly granitic, with fine gravel and sand beneath. This indicates a complicated origin for the terrace. The moraine is a recessional one, located five miles back from the terminal moraine at Millersburg, Ohio. It is of great size and likely to be overlooked as a glacial feature on that account. It is crescent-shaped with concave side toward the Holmesville terrace, having its two horns west and northeast of the terrace a mile apart. Numerous kettles with a kettle pond are found on its surface and border. These have been well preserved by virgin forests recently removed. Drift material 31 per cent. foreign, some Corniferous limestone from Lake Erie region being found. The terrace structure is accounted for by supposing an impounded lake between the moraine and a stage of ice recession to present site of north edge of terrace. The lower layers of terrace derived from the sediment of this lake; the boulder bed from the melting of the receding ice. The subsequent drainage of the lake around the western horn of moraine, caused the débris to collect in front of the face of ice and increased by material brought out from an interglacial tunnel at northwest corner of terrace, involving an outwash plain distributed as upper surface of the terrace. Steep sides caused by a rapid abandonment of the valley north of the terrace.

Diverse ancestry of great basin lakes: CHARLES KEYES.

Explanation of the former existence of desert lakes of great size in western America on the basis of once greater regional humidity becomes notably inadequate when it is realized that hardly any two of these vast sheets of water have had the same origin. Recent quantitative measurement of neighboring glaciation renders this agency a singularly inconsequential factor. All things considered it is inferred that the rise and decline of these great lacustral anomalies of the western arid

country are not necessary consequences of changing climate, but that they, with all their attendant phenomena, are readily accounted for without recourse to meteoric agencies other than those in active operation in the region at the present time. The genesis of these desert lakes is as varied as that of lakes in the garden spots of earth.

Some economic mineral deposits of east Tennessee: C. H. Gordon.

Superficial dip of marine limestone strata: Kirtley F. Mather.

Petroleum geologists have long recognized the necessity of distinguishing between the inclination of beds due to purely surficial causes and that resulting from crustal deformation. The latter only is indicative of the underlying structure. Limestones may depart from horizontality as a result of groundwater action assisted by gravity. The apparent dip thus caused may extend uninterruptedly for considerable distances along hillsides and may closely simulate folded structures. Examples will be cited from the Ordovician limestones of Ontario and from the Mississippian limestones of Kentucky. The dip of limestone beds, as of all sedimentary formations, conforms originally to the slope of the floor upon which the bed is deposited. This floor may be quite irregular, as in the case of the pre-Cambrian complex upon which rest the Ordovician limestones of eastern Ontario. Quaquaversal structures in certain limestones near Kingston, Ontario, are due to deposition of those essentially clastic limestones upon the flanks of granite or gneiss hills rather than to tectonic disturbances. Submarine erosion contemporaneous with the accumulation of clastic limestones may repeatedly roughen the sea-floor and result in the development of cross bedding on a large scale. As illustrated by Mississippian limestones in Allen county, Kentucky, original dips as great as 12° have thus been caused. Their correct interpretation may be deduced only when the exposures are unusually extensive and perfect.

On the mechanics of the great overthrusts: Rollin T. Chamberlin.

In the literature of structural geology it is commonly stated that thrust faulting under compressive stress tends to take place along planes which are inclined approximately 45° to the direction of the applied force. With qualifications, this is true of the ordinary reverse fault. But field studies in the last few years have brought to the attention of geologists impressive evidence of the wide prevalence of a distinctly different type of fault, namely the great low-angle overthrust. Its distinguishing characteristics are the very low inclination of the fault plane and the extraordinary horizontal displacement often attained. The astonishing amount of horizontal displacement is possible because of the low inclination of the plane of slippage which shows no tendency to obey the law of 45° fracture. The low angle of the fault plane seems to afford the key to the problem of the overthrust. An analysis based upon the principles of mechanics, aided by experimental studies with plaster, paraffine, clay and sand in various combinations, seems to indicate that the fault plane in the great overthrusts breaks horizontally, instead of at 45°, because of the operation of a number of factors, chief of which are: (1) The normal or direct component of the stress which acts as a frictional resistance to shearing by the tangential component of the stress. With a lowering of the angle of fracture from 45°, the intensity of this frictional resistance is diminished more rapidly than is the intensity of the tangential, or shearing stress. This makes fracturing easier at angles somewhat less than 45°, though the fault plane remains still far from horizontal. (2) Rotational strain, developed from compressive stress (*a*) in heterogeneous material by bedding, or similar structures, which present just the right differences in competency; (*b*) in homogeneous material by (1) any increase in the intensity of the tangential stress in the upper portion of the mass undergoing thrusting with respect to that in the lower portion; (2) by any factors which will lessen the resistance of the surficial portion while the deeper portion remains less affected, and (3) by any factors which will increase the resistance of the deeper portion subject to thrusting, while the upper portion remains freer to yield. Rotational strain is competent to cause fracturing at any angle between 45° and 0°, depending upon the strength of the rotational element. (3) Piling up of material in the first stages of deformation, thus increasing the gravitative or vertically acting force. Acting in conjunction with the horizontal thrusting force, this may cause a lowering of the angle of fracture. (4) Possible minor factors, as heterogeneous material, relatively great length of deformed mass (after analogy of long column), shape, etc. To these factors, operating singly or in various combinations according to the special requirements of each particular case, are attributed the peculiarities of the great overthrusts.

Rollin T. Chamberlin,
Secretary

(*To be concluded*)

SCIENCE

Friday, May 17, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE VALUE AND SERVICE OF ZOOLOGICAL SCIENCE[1]

VALUE TO THE INDIVIDUAL

The science of zoology is a body of organized knowledge, huge, impersonal, influential. Touching human concerns on many sides, it has been variously regarded: now as a pillar of philosophy, now as a handmaiden of esthetic, or again as a necessity alike to spiritual progress and to various indispensable achievements in the practical world. Powerful in itself, to other disciplines its contributions of hard fact and substantial theory have been many and in the aggregate profoundly significant.

Philosophies, however, are the creations of philosophers. The laws that we apply to diverse aspects of beauty we have framed ourselves. Eugenics and medicine, agricultural practise and the dogmas of religion—all are the works of the human imagination. As attention shifts thus from the product to the producer, an aspect of zoology is revealed that makes at once a more intimately personal appeal.

It is on this aspect that I would now focus your attention. Its appeal is to the individual human being apart from his professional, his vocational existence: to the plain person, pricked by a thousand impulses that must be encouraged and controlled; attended by obligations that must be measured and met; with opportunities for pleasure that he would do ill to lose; with opportunities for service that may carry him unfaltering to the cannon's mouth; ready to see in commonplaces the

[1] Symposium before the Zoological Society of America, Minneapolis, December 29, 1917.

wonders that provide him with motives for action; who, in short, must accommodate himself to a real world by practising the absorbing art of living.

It may not be amiss to enter somewhat more concretely into the life of this everyday individual. For not infrequently in the past has a large portion of his inumerable and varied wants been slighted by a training dominated by a more limited professional ideal.

These wants may be divided, for convenience of treatment, into three groups. Of the first group little need be said. It concerns the upkeep and repair of the human mechanism. It comprises obvious wants that are supplied by well-known rules of hygiene and regimentation, by personal habits and ordinary common sense; by agencies for the production and distribution of the necessaries of life; by food and sanitary inspection; by physicians; by the growing round of organizations for social welfare that aim to care for the individual whatever he may do or be able to do for himself. The satisfaction of these wants comes thus in the routine of civilized life—a routine in which, it is unnecessary to point out, zoology plays an ample part.

In the second group may be placed the less obvious and immediate necessities of citizenship—opinions that must be formulated, judgments that must be made, actions that must be directed toward advantageous social and political ends. How will the voter decide such issues as meat inspection, vivisection, compulsory vaccination, sterilization of the unfit, commitment laws for mental defectives, treatment of criminals, prostitution, marriage? What appropriations will he advocate in support of measures for the public health, including the reportability of venereal diseases? What proportion of the community income will he wish to have expended for the schools? And what, indeed will be his ideas of the functions that the schools of his district should perform?

To such questions may be added others dealing with international intercourse, with the mixing of races, with the tremendous problems of making war and keeping the peace.

These are but stray samples of the manifold human interests that zoology touches firmly, inevitably. If there be teachers of zoology who dwell upon phases of the subject that are not wont to facilitate such implications as these, is it perhaps because the subject rather than what it may do for the individual is receiving the major part of their attention?

In the third group the wants are more subtle, intimate and personal than any thus far considered. Here belong what are called questions of principle and morality; the judgments of motive that must be made, the interpretations of conduct that must be risked, where facts are blurred and honest opinions differ. With these go a multitude of appreciations—of philosophy and art and out-of-doors—of spiritual values and economic results. For, in so far as zoology has contributed toward the development of sound theory in another field, will it be indispensable for the appreciation of that which it has helped to create.

Here we may consider also man's emotional life—his pains and pleasures, his predilections and prejudices, his indifferences, his peculiarities of behavior; and along with these, his countless individual adaptations to the changing conditions of social and family life, where understanding deserves an exalted station to which, in practise, it does not always attain.

There is no need to continue this enumeration of the problems which, sooner or

later, appear in the course of every normal human existence. Nor is it necessary to point out either their dominating importance or the fact that, in the efficient life, they must be met, frankly, successfully.

What is zoology able to contribute toward this end?

Our answer to this question will depend upon what we conceive zoology to be. Owing to the modern tendency toward specialization in the biological sciences, existing conceptions do not form a very compact and homogeneous mass. I shall not take time carefully to discriminate them, however; since they differ for the most part by limitation only. They exhibit varying degrees of incompleteness. One no longer expects morphologists and physiologists, taxonomists and experimental embryologists to agree on a common definition of their common subject. This may be a weakness of the professional attitude; or it may not. But a definition that will include all that these varieties of zoologist might severally propose, will be clear enough for the present discussion. At the same time, it will be sufficiently broad. Though common ground may not be occupied, common limits may thus be set.

Thus defined, zoology exhibits certain attributes that are possessed in common with the basic inorganic sciences, physics and chemistry; and certain other attributes that pertain in general to it alone. Like physics and chemistry, zoology is an organized body of facts and hypotheses developed by the inductive method, and safeguarded by processes of verification that become more rigorous and searching in each science as it develops. Like them, though in less degree, it is an experimental science; and aspires to a closer kinship with them by virtue of the recent increased interest in quantitative methods.

So far, the inorganic sciences and zoology are essentially similar. As soon, however, as the question of content arises, a significant difference appears. For the facts of zoology, though they rest ultimately on a physico-chemical substratum, present as a rule aspects so unlike the customary phenomena of the inorganic world as to produce far different effects upon the imagination. It is a truism that the imagination takes its color from experience. But it is none the less important because of that. Indeed, it is for this very reason that neither physics nor chemistry nor both together can be an adequate substitute for zoology as an aid in the solution of the diverse human problems that have been noted above. Man is an animal; one species among a hundred thousand; one living mechanism among countless millions, controlled by the same factors at bottom that control them all. These, however, are not generally recognized facts. For man is also a mechanism of a complexity that baffles his understanding and confuses his theories of control. Though himself a unit of the living world, his conduct appears to have been strangely free from the influence of a biological point of view. He has written treatises on philosophy that, exhibiting a commendable knowledge of Newtonian mechanics, commonly show no comparable sign of biological experience. His art criticism is as yet dominated by a literary tradition from which it only exceptionally frees itself by some innovation as refreshing as it is rare. Religion has always been slow to adopt the demonstrations of science, especially those that touch her traditions most intimately. Rules and dogmas readily usurp the functions of facts. This is amply true in the pedagogy of zoology itself. Real values here are still matters of varying opinion. The reason is in all cases essen-

tially the same. The differences spring from differences of imagination; which go back to differences of effective experience; which can be expressed, on the whole, in terms of relative ignorance.

One obvious avenue of relief from the general situation lies through the common schools. The inertia of tradition and the embarrassing difficulties inherent in the complexity of the human mechanism and its multiplicity of external relations can be advantageously attacked by beginning early in the individual life the development of a biological point of view. If facts are furnished, not withheld; if teachers recognize the persistent danger of standing between pupils and their wholesome interests; if children are permitted to think candidly about natural processes; if they are encouraged to appreciate the dignity of naked facts, to believe that it is no discredit to a fact that it is true; results will flow in the right direction.

Another avenue of relief that concerns us as college teachers more closely, lies through the courses of zoology, especially the general courses, that are being offered by our colleges. If the common schools accept their opportunities and responsibilities, ours are not thereby lessened. What are the functions of the colleges in this connection? What is the nature of the material that zoology offers them for their use? I shall consider the second question first.

In the first place, zoology offers facts that are of immediate practical utility in a thousand ways, facts that are associated commonly with the technic of vocations, and facts that are neither the one nor the other. There may be no fundamental differences between the facts thus classified. For the character of a fact can not be altered by the accident of its immediate applicability. In certain respects, however, the classes themselves differ. The first and second are small, specialized and circumscribed in comparison with the much larger, more diversified and expansive third. They make a more limited appeal to the imagination. They confine it, setting limits to its flights before it has tried its wings. For this reason, and this reason only, I contemplate with some reserve the recent mushroom growth of vocational courses in our secondary schools, with the substitutions they usually entail; although, regarded as protests against a certain detachment from the concerns of every-day life which zoology has been known to assume in the past, they possess merit.

However that may be, and however the facts themselves may be classified, as a whole they embody certain conceptions that are characteristic of organic as contrasted with inorganic science; for example, the living organism, growth, development, evolution, behavior, adaptability. These are all vivid, dynamic conceptions. They stress movement, change, the process rather than the result, the activities of organisms living rather than their architecture dead; in all cases, the reference of data to dynamic standards, such as the interpretation, for example, of structure in terms of function. Thus, a cat's leg, as a collection of bones and muscles, nerves and blood vessels, lacks the significance which as a living moving appendage it possesses. Yet it must be dissected if its beautifully coordinated movements are to be adequately appreciated. It must appear transparent to the mind's eye. Function and structure stand thus in an indispensable relation to each other. But there remains this difference between them, that while structures have no meaning apart from their activities, the latter apart from the former have meaning without significance. Physiology

and morphology necessarily march hand in hand; though I am of the opinion that for the fullest development of the interests of the individual, the former should set the pace.

In the second place, the facts of zoology fill a vast and varied domain that extends from physics and chemistry, on the one hand, to sociology and psychology, on the other. They concern life in its most elementary aspects and its most complex and subtle manifestations as well. They record the limits of our knowledge of the physiological mechanism, contributing at once to the analysis of the behavior of paramecium and the instinctive, even the rational life of man.

For purposes of intensive cultivation, this domain has been broken up into many subdivisions. All of these have prospered; in some cases to such an extent that, absorbed in their own immediately enticing concerns, their stewards have lapsed into a certain forgetfulness of their neighbors. This is a normal accompaniment of specialization. But it can hardly be said to be desirable either for the development of the science as a whole or for the individual who may chance to come within range of its influence. Such individuals there are, however, preparing in our graduate schools to teach zoology to the elementary students of the next generation: students of cellular biology, perhaps, who are frankly uninterested in animal behavior; or students of animal behavior to whom genetics is but a name; or students of genetics who neglect comparative anatomy; or comparative anatomists who care nothing for cellular biology. As special workers they will fit somewhere into the professional machine. As teachers of the future, they can promise the elementary student no more than they themselves possess. Which is a pity, when zoology has so much to offer.

In the third place, zoology is growing with great rapidity. It is a youthful science. The great mass of its resources are as yet undiscovered, though they lie everywhere about us. With a large and growing literature, its rewards are as yet not primarily for the bookish. They may be had by any alert and active mind. There is a fine democracy in the opportunity it offers. Its secrets may be bared by old or young. Though years of technical preparation are required by some types of problem, little or no technic is necessary for the solution of others that are well worth any one's trouble and time. The frontiers of zoology are constantly shifting. The written record is constantly being revised. This rapid growth brings movement, novelty, wholesome stimulation.

As a consequence, in the fourth place, zoology presents peculiar advantages to the elementary student in school or college, for the use of the constructive imagination. From the beginning he may develop his instinct for workmanship on problems that belong to the fabric of the world's work. From the beginning he may face issues that are not merely conjured out of his ignorance but are issues in the learned world as well. And he may contribute directly toward bringing them to an end. In zoology he may return to a wholesome apprenticeship as in the days when students were the assistants of their masters, shared their hopes and ambitions and felt the stimulus of their creative activity.

That is to say, he may if it is permitted. The subject invites, problems await him, problems that he can make his own and that thus stimulate the invention of methods, careful observations, discriminations of significant details in otherwise dead facts.

The subtle lure of discovery is here, and the dignity of personal achievement. The spirit of research is here, to transform the drudgery of soulless routine into the excitement of self-realization. High enthusiasms are here, moments of strong emotion and lofty aspiration.

This is all to be had, if it is permitted. There are reasons why it is not always permitted. Sometimes they are reasons of calculated educational policy, more often of administrative expediency. But what is of far more importance than the reasons to the individual student are the courses he is permitted to elect. It is profoundly unfortunate if he feels, on entering the zoological laboratory, that he has somehow lost his intellectual freedom, that he has been shorn of his initiative, that what is henceforth expected of him is a docile and orderly record of certain selected observations that he is directed to make.

Such cases occur, though exceptionally. That they do not occur more commonly is because the habit of docile indifference has already been acquired in the preparatory years. The pupil has frequently learned, like the Prussian soldier, to think by command only. He is ready to do what he is told to do. He is helpless when not told. He regards the instructor as a taskmaster, and the laboratory as a drill ground where his own responsibility is reduced to the minimum, where personal desires are of no practical value, but where it is useful, with a view to graduation, to be silent and obey.

We all recognize the deplorable type. Do we accept it? I am sure that we do not. For if we should, the little good that zoology might accomplish in the individual life under such circumstances would be negligible in proportion to the wastage that would surround it.

If we do not, what then?

One plan of action at least may be suggested of the many that are doubtless in practise among you. It would adopt all necessary measures to save the student's initiative, quicken his imagination, teach him the trick of invention, make a true researcher of him, if you will, in spirit. It would insist that each student regard the laboratory as his workshop where, with the facilities to be obtained there, he may think out and solve his own problems. It would set no conventional boundaries to the laboratory, which would best be considered the place where the student happened to be at work, whether in the college laboratory proper, or in the field, or at home. But it would stipulate that he do not come to the laboratory empty-minded; that he bring an inquiry that could best be investigated there, and that he develop the investigation with all due regard to care in observation, logic in thought, clearness and significance in record. The immediate environment would be the primary source of his material. Laboratory manuals would be limited to necessary technical directions. The classroom would serve for the discussion of principles, the formulation of problems, the criticism of results and the connection between it and the laboratory and the library be made as intimate and practical and workmanlike as possible.

In some such way the colleges might discharge a portion of their tacit obligation to place zoology in fullest measure at the service of the individual citizen, for the satisfaction of those wants that pertain to his personal life, whatever his vocational interests. Indeed, it is to the colleges especially that he must look for this help. For the colleges produce the teachers of zoology the country over. And the teachers touch the public with an intimacy of contact that is their privilege alone.

Harry Beal Torrey

Reed College

UTILITARIAN VALUES OF ZOOLOGICAL SCIENCE[1]

I HAVE been asked to contribute my bit to the symposium on the value and service of zoological science by discussing the utilitarian aspects of the subject. The first procedure is, naturally, to inquire into just what we mean by utilitarian. Utilitarian, that is, useful! Useful for what?

If we restrict the meaning of utility to service in filling our pockets or our stomachs, or in protecting ourselves and our possessions from various dangers, in other words, to economic phases of the subject—and I suspect that this is what I am intended to do—then I can not pass on to my more specific assignment without the parting protest that valuable as are the economic applications of zoology, I would rank them as far subordinate to the part that this science has played in widening the intellectual horizon of man and, notably, in helping to cast out from the human mind the twin devils of superstition and ignorance. The firm establishment of the theory of organic evolution is in itself perhaps the greatest event in the development of human knowledge. Not only has it clarified and made significant the uttermost limits of biological science, but its unifying principles have irradiated into all other sciences. Its spirit has pervaded and rationalized the whole realm of human thought.

Before passing to the economic aspects of the science I would also call attention to its unsurpassed value as a means of educational discipline. Somewhere in our educational scheme students should be taught to weigh evidence, in order that they may learn to deal adequately with facts and to evaluate the conclusions of others. This ability can be gained only by actual practise. And nowhere outside of zoology can we, with as little expenditure of effort, find better materials for training in the fundamental processes of observation, perception of relations and inference. Nowhere are there greater opportunities for developing that questioning, impartial, problem-solving attitude of mind which must obtain, if truth and sanity are to rule the world.

But coming now to the more conventional conception of utility as distinct from abstract truth, beauty or the refinements of existence, the science of zoology can boast a proud record of helpfulness in the practical affairs of life, and can point to a lusty brood of economic offspring.

During the past twenty-five or thirty years, in order to justify our existence, however, as professional zoologists we have had to call the roll of these so frequently, that most of you already know the list by heart and can not look forward to its rehersal anew with much but ennui. I shall endeavor, therefore, to make the story as mercifully short as possible.

1. *In Relation to Health and Disease.*—Perhaps it is in the realm of health and disease that some of the most obvious utilizations of zoological knowledge and zoological materials are evident to-day. While our first thought flashes bacteriology before us as the science *par excellence* in medical advancement, we must not forget that bacteriological progress has been and is inseparably linked with animal experimentation, that the great studies in immunity, or on the pharmacological action of drugs are essentially studies in animal life, and that more and more diseases are being shown to be of animal origin or conveyance.

Disease, plague and famine are all biological problems, and the great science of medicine itself is essentially a branch of applied biology. Medicine passed from the

[1] Symposium of the Zoological Society of America, Minneapolis, December 29, 1917.

realm of demonology, incantations, amulets and miasmas, hand in hand with advancing zoological knowledge. The members of the great sister societies meeting with us here to-day, ostensibly as allied medical devotees, are nothing in the world but camouflaged zoologists. For proof of my statement you need look only at the program of the so-called Anatomists. Have they not outdone the Zoologists themselves in presenting a purely zoological program? Moreover it is one which can not even be appreciated without considerable background of zoological knowledge. Contemplating the Zoologist's and the Anatomist's programs side by side, I am reminded of that foolish bit of verse attributed to Bill Nye,

> The Autumn leaves is fallin', is fallin' everywhere,
> Is fallin' through the atmosphere, and likewise through the air.

Can any one here, even with a Taschiro's biometer, detect a difference between the anatomical atmosphere of the one program and the zoological air of the other?

Next glance at the program of the Physiologists or of any of the other affiliated societies and does not a somewhat similar condition exist? In all of these are we not merely looking through different windows at the common science of zoology? Is not an acquaintance with the fundamental principles of the latter the most logical and direct approach to any one of them?

The study of zoology not only gives the beginning medical student practical skill in preparing for the study of the human body, but it also supplies him with a fund of conceptions and develops an attitude of mind that should be of great service to him in all his future work. Acquaintance with a wide variety of animals has invariably proved a boon to physiologists, and knowledge of the life of any form throws reflected light upon human life.

If more specific reference is required to show the relation of zoological science to sanitation and medicine, then let me call attention to the fact that some of our most dread diseases are of animal origin. At once comes to mind such scourges as syphilis, sleeping sickness, malaria, various amebic diseases, hookworm infection, elephantiasis and other filarian diseases, spotted fever, relapsing fever and many other fevers. And where the malady itself is not directly attributable to an invading animal parasite, it is in many cases conveyed by animal carriers. For instances of this we have only to think of bubonic plague, yellow fever or typhoid fever.

So important has become the subject of animal parasites in relation to man and useful animals that not a few zoological departments in our larger universities have thriving courses in animal parasitology. These are elected not only by prospective medical students but by agricultural and veterinarian students and by practically all who expect to go into any branch of economic zoology. Even students of plant pathology are finding that they have to look beyond their rusts, smuts, molds and bacteria, and learn something of nematodes, soil protozoa and other animal forms.

2. *In Agriculture, Animal Husbandry and Related Interests.*—Possibly even more conspicuous than in medicine are the applications which have been made of zoological knowledge to the field of agriculture and related interests. When we realize that injurious insects alone cause an annual loss in the United States of well over a billion of dollars, and that with proper knowledge of insect life and intelligent application of this knowledge, probably at least half of the loss could be avoided, the importance of economic entomology is at once evident. And when we add to this the long list of disabilities and deaths of our common ani-

mals, poultry, fish and game due to infestation by animal parasites—protozoa, tapeworms, flukes, threadworms, various insect larvæ and what not—we can realize that to cope with these pests successfully requires no inconsiderable knowledge of zoological principles and zoological forms.

Where in science can one find more of thrilling interest than in our quest throughout the animal kingdom for friends which we may pit against our insect and other foes? This setting of one species to prey upon another, as of lady beetle on scale-insect, and the world-wide search for suitable predaceous forms which it involves, requires, of course, a thoroughgoing understanding of the life relations of animals in general.

The great field of economic zoology is demanding more and more workers, both in the service of the federal government and that of the various states. Now the call comes for a mammalogist or a practical ornithologist, next for some one to investigate an epidemic among fish, then a man to help fight horticultural or agricultural pests, or perhaps the demand is for a protector of forest trees, an inspector of nursery stock, a scientifically trained apiculturist to safeguard and foster the bee-keeping interests of the state, and so the list goes on.

Another phase of applied biology that is attracting much attention to-day is that of genetics as applied to our farm crops and farm animals. The very fact that departments of experimental breeding or genetics are being established in practically all of our agricultural colleges and experiment stations is sufficient commentary on the practical value of this kind of work.

3. *Conservation.*—The whole subject of conservation of natural resources is so prominently before us at present that it requires but passing mention here. The depletion of our lakes and streams, the destruction of our bird life, the extermination of our game, is a story well known to you all. It is obvious that, first of all, those who are to undertake the correction of these evils must be thoroughly informed. Intelligent management of the situation, suitable regulations and restorations require much knowledge of animal life in general, such as that possessed by well-trained economic zoologists. Lack of such knowledge is accountable for much of the inadequacy of the measures in vogue in many places to-day.

4. *Fisheries.*—Again, the practical bearing of zoological knowledge upon such industries as our fisheries is patent at first glance. When we consider that one season's catch of salmon will run more than 455,000,000 pounds, that the annual yield of whitefish is some 75,000,000 pounds, that the catch of herring will total above 3,000,000,000 individuals, and that the quantities of many other kinds of fish taken run into correspondingly large figures, it is evident that our fisheries are one of our most important sources of food. In dollars the aggregate must be an enormous sum. The Pacific coast catch of salmon alone may in a single season run over $25,000,000. The work being done by the United States Bureau of Fisheries with its thirty-six permanent hatcheries and nearly one hundred auxiliary stations, together with that of the various State Fish Commissions may legitimately be reckoned as economic zoology. There is increasing demand for adequately trained zoologists to enter this practical field. Since such work embraces not only fish, but includes the aiding and controlling of the industries which have to do with such forms as the oyster, the lobster, the shrimp, the crab, the clam, the fresh-water mussel, the sponge and other types, a good foundation of zoological knowledge is clearly nec-

essary for its successful prosecution. In spite of all efforts so far toward regulating seasons of operation and quantities of catch, and notwithstanding much aid by artificial propagation and the control of epidemic diseases, the supply in every field is diminishing. If we are to strike a balance short of extermination, it is evident that much important investigation remains yet to be done.

5. *As a Practical Foundation for Education and Philosophy.*—Animal behavior and comparative psychology constitute the most logical approach to the problems of human psychology. For complex as is the human mind, and artificial as is human society, it has at last been recognized that human processes, mental, neural or vegetative, are only special cases of the more generalized processes of lower animals. The fact is coming to be more and more appreciated that biological researches, biological methods and biological principles can be utilized to a much greater extent in solving the problems of psychology, child study, pedagogy, sociology, philosophy and ethics than they have been in the past. A thorough course in zoology, together with a good digest of the evidences and the factors of organic evolution, a review of our present knowledge of the principles of heredity, and an understanding of the recent work in animal behavior, would seem well nigh indispensable for balance and perspective in the fields of psychology, education and philosophy.

6. *Eugenics.*—Still another field which is of the greatest importance to human welfare, that of eugenics, is fundamentally linked with a knowledge of zoological principles. Practical eugenics, a subject upon which the very perpetuation of our national life depends, consists of the attempt to better the human race innately by an intelligent attitude toward marriage. And the keynote to the intelligence demanded in this connection is knowledge of the laws of heredity.

Since it is with the lower forms of life that we must do our experimenting to establish and test out these laws, and since a comprehension of all that is implied in heredity and its converse, variation, necessitates an understanding of fundamental principles that can be attained only through acquaintance with a considerable range of animal life, a preliminary training in general zoology becomes the soundest method of approach to this important field. A knowledge of different modes of life and development, and an understanding of the causes for the decay and extinction of races of animals, sheds direct light upon the present and the future of the human race, and should be the possession of every one who would see eugenics in its true relations.

7. *Public Support of Economic Measures.*—Lastly, I would urge, from the purely utilitarian standpoint if you please, the necessity of some knowledge of animal life and animal forms, and of their relation to human life and problems, on the part of the general public. The maintenance of regulations for sanitation, for the conservation of natural resources and for similar undertakings, must be in large part a matter of intelligent cooperation of the public. This means that the public must be made to see the purpose of our endeavors and to understand the facts and principles upon which such cooperation is based. Before the average citizen will respect and promote our general economic regulations he must understand why restrictions on hunting and fishing are desirable, why pollution of water supplies is dangerous, why food-inspection, health-inspection, vaccination and quarantine are necessary, why he should approve of federal or state appro-

priations for the establishment of experiment stations, laboratories and the prosecution of many forms of scientific investigation, and nowhere can he get this information so effectively as through biological studies. The scientific ideas and ideals upon which such measures are based if once drilled into the student by concrete example and experiment will inevitably affect his conduct through all his future life. Public encouragement, or at least public tolerance, must exist before we can travel far in the application of biological principles to the welfare of the community or of the nation.

M. F. GUYER

UNIVERSITY OF WISCONSIN

SCIENTIFIC EVENTS

THE LAKE LABORATORY OF THE OHIO STATE UNIVERSITY

FOR the session of 1918 the Lake Laboratory will be located at Put-in-Bay, which is a beautiful harbor on South Bass Island in Lake Erie. This island lies about five miles off the south shore of Lake Erie and twenty miles north of Sandusky, Ohio. It is only a few hours by lake steamer from Cleveland, Toledo and Detroit. South Bass Island is one of the group of three Bass Islands, the others being Middle Bass and North Bass. Nearby are Green Island, Rattlesnake Island and several other smaller islands. This situation offers an excellent location for a Great Lakes biological station. Lake Erie is probably the richest in flora and fauna of any of the Great Lakes. The islands offer a varied environment of rocky shore, sandy beach and woodland. On the mainland, within easy reach, are extensive sand dunes, large marshes, woodlands and streams.

The laboratory will have quarters in the building of the fish hatchery operated by the state of Ohio. The second floor of this building furnishes ample room for lecture and table space. On the ground floor there are large aquaria and several tiers of hatching jars supplied with running water. The laboratory owns a small gasoline launch and rowboats. In addition to this the boats and field equipment of the Fish Hatchery will be available. There is a large boat which will enable workers to visit any part of Lake Erie.

If the change for this year from the former location at Cedar Point to Put-in-Bay proves to be advantageous it is hoped that eventually close relationships can be established with the fish cultural activities in Ohio. The state authorities are giving their hearty cooperation. The staff for the coming session will comprise Dr. F. H. Krecker, Ohio State University, Acting Director, who will give a course in ecology of aquatic animals; Dr. S. R. Williams, of Miami University, who will offer a course in the morphology of fresh-water invertebrates; Professor M. E. Stickney, of Denison University, who will have charge of the work in botany, and Professor Z. P. Metcalf, of North Carolina Agricultural College, who will give a course in entomology. Professor Herbert Osborn, research professor of Ohio State University, and Dr. R. C. Osburn, head of department zoology and entomology at Ohio State University, will be in attendance for parts of the session.

While the courses mentioned above are given for the benefit of those who may need them, the research activities of the laboratory are to be emphasized. Persons who may desire to engage in independent investigation of biological problems will be cordially welcomed. No fees will be charged such individuals unless for special equipment or materials supplied.

Comfortable living accommodations will be afforded in a furnished cottage adjoining the Fish Hatchery. Board will be given at cost.

The acting director, Dr. F. H. Krecker, will be glad to give any information desired. He should be addressed until June 15 at Ohio State University, Columbus, Ohio, after that time at Put-in-Bay, Ohio.

ANTI-TYPHOID INOCULATION

DR. W. W. KEEN has addressed the following letter to the Secretary of War:

In a four-page pamphlet entitled "Why Is My Soldier Sick," issued by the National Anti-vivisec-

tion Federation, with headquarters at 456 Fourth Avenue, New York City, are published two resolutions passed by the New York Anti-vivisection Society at its annual meeting January 31, 1918, and forwarded to you officially. The second resolution reads as follows:

Be it further resolved, That a copy of the foregoing resolution be forwarded to the Secretary of War as our official protest against the medical department's claim that serum inoculation is a necessary war measure and for that reason made compulsory, and as our protest against compulsory inoculation when the individual soldier conscientiously objects thereto; and we point to the provision of exemption now made by Great Britain, that power having been forced to rescind the rule of compulsion after the alarming effects of inoculation were disclosed.

It has long been a matter of common knowledge and deeply regretted by the medical profession that Great Britain has never made anti-typhoid vaccination compulsory, as it fortunately is in our own army.

In an article entitled "The Red Cross and the Anti-vivisectionists," a copy of which I am inclosing, I have shown by irrefutable facts how extraordinary the protection of the anti-typhoid vaccination has been in our own army and in the British army.

Although I knew that the statement in this resolution was an absolute falsehood, I preferred to have an authority which was beyond all question. Accordingly, on Saturday, April 27, I sent the following cable to Surgeon-General Goodwin, who occupies the same post in Great Britain that General Gorgas does in this country:

SURGEON-GENERAL GOODWIN, War Office, London.
Has anti-typhoid vaccination ever been compulsory in British army?

KEEN

To this on Monday, April 29, I have received the following reply:

London, Professor Keen, Philadelphia.
Anti-typhoid inoculation has never been compulsory in British army.

GOODWIN

You will observe, therefore, that this is a flat contradiction of the false assertion of the New York Anti-vivisection Society.

Nearly all of the British army has been voluntarily vaccinated against typhoid fever. Colonel F. F. Russell, in Surgeon-General Gorgas' office, authorizes me to say that he understands that ninety-nine per cent. of the British soldiers are vaccinated against typhoid fever. The reason for this is that they have seen how extraordinarily complete is the protection offered by the anti-typhoid inoculation. At this time the fate of the war depends largely on the health of our army. It is in my opinion equivalent to disloyalty to deprive our soldiers of this protection and sacrifice their lives instead of the lives of a few rabbits, guinea pigs, cats and dogs.

Yours very respectfully,

W. W. KEEN

THE SILLIMAN LECTURES

THE Silliman Lectures at Yale University, to be delivered from May 21 to 29, will be based on seven of the twelve chapters contained in the anniversary number of the *American Journal of Science,* to be published about July 1. A Silliman lectureship volume, embracing the contents of this number, with some additions, will also be issued later by the Yale University Press. The lectures will be as follows:

I. The American Journal of Science from 1818 to 1918, by E. S. Dana. May 21, 4 P.M.

II. A Century of Geology—Historical Geology, by Charles Schuchert. May 22, 4 P.M.

III. A Century of Geology—The Growth of Knowledge of Earth Structure, by Joseph Barrell. May 23, 4 P.M.

IV. The Development of Vertebrate Paleontology, by Richard S. Lull. May 24, 8 P.M.

V. The Progress of Chemistry during the Past One Hundred Years, by Horace L. Wells. May 27, 4 P.M.

VI. A Century's Progress in Physics, by Leigh Page. May 28, 4 P.M.

VII. A Century of Zoology in America, by Wesley R. Coe. May 29, 4 P.M.

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE annual meeting of the American Association for the Advancement of Science and of the national scientific societies affiliated with it will be held at Baltimore, from December 27 to December 31. Boston had been selected as the place of meeting this year, action recommending that the meeting be held in that city having been taken at the meeting in New York City two years ago. In view, however, of war conditions and of the large number of scientific men now working at

Washington, it seemed desirable to select a place to which the amount of traveling would be reduced as much as possible, and where a meeting concerned with problems of national defense and national welfare could be held to best advantage. The situation was carefully considered at the meeting of the committee on policy held in Washington on April 22, and it was decided that it would be desirable to meet in Baltimore. President Goodnow and the professors of the scientific departments of the Johns Hopkins University having cordially welcomed the plan, it has been definitely decided that the meeting will be held in Baltimore. A committee consisting of the permanent secretary, Dr. L. O. Howard, Dr. W. J. Humphreys and Professor J. C. Merriam has been appointed to report on a general plan for a program that will make the meeting of the greatest possible service to the nation.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting of the council of the Boston Society of Natural History, it was voted that the Walker Grand Honorary Prize, in the shape of a one-thousand-dollar Liberty bond, be awarded to Professor Jacques Loeb, of the Rockefeller Institute, New York, in recognition of his many published works covering a wide range of inquiry into the basic concepts of natural history. The Walker Grand Prize is awarded every five years, under the terms of the will of the late William Johnson Walker, "for such scientific investigation or discovery in natural history," first made known and published in the United States, as the council of the society shall deem deserving thereof.

AT the annual meeting of the Boston Society of Natural History, Professor Edward S. Morse, of Salem, was reelected president. He has been a member of the society for 60 years, and in point of seniority is exceeded only by President Emeritus Eliot of Harvard University. Other officers elected were: *Vice-Presidents,* Nathaniel T. Kidder, William F. Whitney, Charles F. Batchelder; *Secretary,* Glover M. Allen; *Treasurer,* William A. Jeffries; *Councillors for three years,* Reginald A. Daly, Merritt L. Fernald, William L. W. Field, George H. Parker, John C. Phillips, William M. Wheeler, Edward Wigglesworth, Miss M. A. Willcox. A single Walker prize, of sixty dollars, was awarded in the annual competition. The Prize essay was on "The Seasonal Distribution of Diatoms at Woods Hole, Massachusetts," by Miss Elizabeth D. Wuist, of the Osborn Botanical Laboratory, Yale University.

THE Franklin Institute has awarded its Howard N. Potts Gold Medal to Dr. A. E. Kennelly, of the Massachusetts Institute of Technology, Cambridge, Mass., for his original work on the hot-wire anemometer. The purpose of the device is to balance the heat produced by a measured current of electricity through a small wire against the cooling effect of a current of air, or other gas, moving across the wire. The same award was also made to Professor Louis Vessot King, of McGill University, Montreal, Canada, for his improvements in the hot-wire anemometer, his successful investigations of various physical problems, and for his making of this instrument a practical device for anemometry.

THE Academy of Sciences of Vienna has awarded the Baumgartner prize to Professor A. Einstein.

SIR AUREL STEIN has been awarded the Tchihatchef Prize of the Paris Academy of Sciences for his geographical work.

DEAN EDWARD M. FREEMAN, chief of the division of plant pathology and botany of the college of agriculture of the University of Minnesota, has been asked to become chairman of the agricultural committee of the National Research Council.

DR. RALPH ARNOLD, of Los Angeles, the geologist, has been appointed as a member of the Board of Tax Reviewers, in connection with the administration of the War Revenue Act.

DR. CHARLES F. BOLDUAN, director of the Bureau of Public Health Education of the Health Department of New York City, has resigned.

Professor J. H. Ransom, for eighteen years in charge of general chemistry in Purdue University, has resigned, his resignation to take effect at the close of the present academic year.

Dr. Elbert C. Lathrop has resigned his position as biochemist in the laboratory of soil fertility investigations, U. S. Department of Agriculture, to accept a research position with the Jackson laboratory of E. I. du Pont de Nemours and Company of Wilmington, Del.

Dr. John J. Tigert, head of the department of psychology of the University of Kentucky, has been granted leave of absence and will go at the close of this year to France into army Y. M. C. A. work.

Arthur Francis Buddington, A.B., M.S. (Brown, '13), Ph.D. (Princeton, '16), an instructor in the department of geology at Brown University, has been appointed a civilian instructor in the non-flying section of the aviation ground school at Princeton.

Professor Francis G. Benedict, director of the Carnegie Nutrition Laboratory in Boston, gave an address before the medical staff of the Base Hospital at Camp Devens, Ayer, Mass., on May 3, 1918, on the subject "The cost of overeating," based upon a research on undernutrition carried out with a group of twenty-five men at the International Y. M. C. A. College at Springfield, Mass.

Professor George A. Hulett, of Princeton University, gave recently a lecture on "Gas warfare" at the University of Minnesota.

Dr. J. A. Detlefsen, of the University of Illinois, gave the annual address at the meeting of the Kentucky Academy of Science on May 4, on recent developments in genetics.

A group of students of man have formed a "Galton Society" at New York City. A first meeting of the charter fellows took place at a dinner given by Professor H. F. Osborn, on April 17. The other charter members are Madison Grant, George S. Huntington, Charles B. Davenport, C. H. Merriam, William K. Gregory, J. H. McGregor, Edward L. Thorndike and Edwin G. Conklin. Additional members were elected as follows: Dr. Earnest A. Hooton, Gerrit S. Miller, Dr. Raymond Pearl, Dr. Frederick Tilney, Dr. Clark Wissler and Professor H. H. Wilder. It is proposed to elect more members from time to time up to twenty-five in number. Dr. Davenport was elected president and Dr. Gregory secretary.

The annual Norman Wait Harris Lectures at Northwestern University, which were founded to stimulate scientific research, have recently been given by Professor Thomas C. Chamberlin, head of the department of geology at the University of Chicago. The general subject of the course was "Glaciers, ancient and modern," and the individual subjects were "Birth, growth and mature stages of glaciers," "The decadence, death and residual products of glaciers," "Existing glaciation and the place it gives the present epoch in the cycle of climates." "The glaciation of the last geological period," "The glaciation of the earlier geological ages," and "The assigned causes of glacial periods; the climatic outlook." The six lectures were given on successive nights to large audiences, and a dinner in honor of the lecturer was given at the University Club of Evanston by the university trustees and members of the faculty.

A meeting of the Botanical Society of Washington was held on May 7. Abstracts of the papers presented will be published in the *Journal* of the Washington Academy of Sciences. The program was as follows: S. C. Stuntz: an appreciation: Dr. R. H. True. Collecting data on national forest range plants: Wm. A. Dayton. Nathaniel Jarvis Wyeth and his influence on western botany, with a sketch of his return trip from Oregon in 1833; W. W. Eggleston. Papain from Carica papaya grown in Florida: V. K. Chestnut.

Professor John Henry Comstock, professor emeritus of entomology, Cornell University, lectured before the Syracuse Chapter of Sigma Xi on April 1, on the habits of spiders, and on April 20, Professor Charles H. Richardson, head of the department of mineralogy, Syracuse University, lectured before the Cornell Chapter of Sigma Xi on coal mining with a camera. Both lectures were open to the

public. It is the intention of the two chapters to continue each year this exchange of lecturers.

MR. C. HANNEVIG has donated 150,000 crowns as a memorial to N. H. Abel. The income of the fund is to be used to further mathematical research in Norway.

THE death is announced of Dr. Emile Yung, professor of zoology in the University of Geneva.

THE American Association of Museums meets at Springfield, Massachusetts, on May 21 and 22.

THE Society for the Promotion of Engineering Education will meet at Northwestern University, Evanston, Ill., from June 26 to 29. The dormitories and fraternity houses at which members are to live and Swift Hall of Engineering at which the formal meetings of the society will be held are all on the shore of Lake Michigan in well-shaded grounds. The local committee hopes that its guests will, as a rule, use the late afternoon hours to get acquainted with each other in the open air on the shore of the lake and the committee will endeavor to make it pleasant for them to do so. There will be an informal meeting at the gymnasium on Wednesday evening and both the afternoon and evening of Friday will be devoted to an excursion on the north shore and a dinner at Ravinia Park.

ACCORDING to Director Edwin Brant Frost, of the Yerkes Observatory, the University of Chicago observers of the coming total eclipse of the sun have selected as their principal station Green River, Wyoming, a point on the Union Pacific Railway, lying between Cheyenne and Ogden. This station is situated in the so-called Red Desert, with a rainfall of about ten inches per year and at an elevation of over 6,000 feet. The remarkable transparency of the air in this region makes the station one of the most promising of any along the line of totality. The observing party from the University of Chicago will have about twenty members, including Professor Edward Emerson Barnard and Assistant Professors John A. Parkhurst and Storrs B. Barrett, besides volunteers from the Yerkes Observatory and other institutions. Some of the volunteers will use apparatus at Denver. It is hoped also that the weather will permit simultaneous observations with the spectroheliograph at the Yerkes Observatory by Dr. Oliver J. Lee.

THE Department of Terrestrial Magnetism of the Carnegie Institution of Washington, in accordance with a request from Captain Roald Amundsen, has supplied for use in his forthcoming Arctic expedition a complete set of magnetic instruments, as also the necessary directions for magnetic measurements and the program of work. Captain Amundsen plans to leave Norway next summer, and has made arrangements on the expectation that his expedition will require about five years for completion. He will make scientific observations of various kinds in the Arctic regions. During a visit by Dr. Nansen and Captain Amundsen to the laboratory of the department on April 5, the final details with regard to the contemplated Arctic magnetic observations were arranged.

WE learn from the *Journal* of the American Medical Association that seven prizes were distributed at the recent annual meeting of the National Academy of Medicine at Madrid, the prizes amounting to over 41,000 pesetas, about $8,200. The themes included vaccine therapy, medical geography and epidemics. One prize goes annually to the professor in the university who has contributed most to the progress of science, and one to a city physician, married and with children, who has sent in the best report on some epidemic.

"THE Organization of Thought," by A. N. Whitehead, reviewed in SCIENCE for February 15, 1918, by Professor C. J. Keyser, has now been published in the United States by the J. B. Lippincott Company of Philadelphia.

AT the request of the mayor of Middletown, Conn., Professor Charles E. A. Winslow, of the department of public health, Yale School of Medicine, assisted by David Greenberg and Ira D. Joel, of the same department, made a survey of health and sanitary conditions and the administration of the health service of

Middletown. The results and their recommendations have now been printed in a pamphlet with an introductory article by Professor Winslow.

UNIVERSITY AND EDUCATIONAL NEWS

Plans are announced for the establishment of a new college for political science in New York City, for which it is said that an annual income of $150,000 is largely secured. The faculty will elect not only the professors but also the trustees, and it is intended that the fullest freedom of teaching and of research shall be given to the professors.

Mr. William H. Porter, of New York, has given $50,000 to Middlebury College, to build a hospital.

By opening its school of medicine to women on the same terms as to men Washington University becomes coeducational in all its departments, similar change having been ordered a few weeks since in the school of dentistry.

It is announced that McGill University hereafter will admit women to the study of medicine and dentistry.

Dr. Herbert E. Hawkes, professor of mathematics, who has been acting dean of Columbia College during the absence on leave of Dr. F. P. Keppel, has been appointed by the trustees to be dean of the college, Dr. Keppel having resigned to accept the third assistant secretaryship of war.

Dr. Florian Cajori has resigned his position of dean of the department of engineering and professor of mathematics at Colorado College, and has accepted the appointment as professor of the history of mathematics in the University of California.

Professor Otto Glaser, of the University of Michigan, has been appointed professor of biology at Amherst College.

DISCUSSION AND CORRESPONDENCE

PROPOSED MAGNETIC AND ALLIED OBSERVATIONS DURING THE TOTAL SOLAR ECLIPSE OF JUNE 8, 1918

Special magnetic and allied observations will be made at various points inside and outside the shadow belt of the coming total solar eclipse, by the department of terrestrial magnetism of the Carnegie Institution of Washington, the Coast and Geodetic Survey, and some other institutions and individuals who have offered their cooperation.

The general scheme of work proposed by the Carnegie Institution Department of Terrestrial Magnetism embraces the following:

1. Simultaneous magnetic observations of any or all of the elements according to the instruments at the observer's disposal, every minute from June 8, 1918, 7 P.M. to 1 A.M., June 9, Greenwich civil mean time, or from June 8, 7^h to 13^h Greenwich astronomical mean time.

(To insure the highest degree of accuracy, the observer should begin work early enough to have everything in complete readiness in proper time. See precautions taken in previous eclipse work as described in the journal *Terrestrial Magnetism*, Vol. V., page 146, and Vol. VII., page 16. *Past experience has shown it to be essential that the same observer make the readings throughout the entire interval.*)

2. At magnetic observatories, all necessary precautions should be taken to insure that the self-recording instruments will be in good operation not only during the proposed interval but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient. (*It is recommended that, in general, the magnetograph be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible be taken to guard against instrumental changes likely to affect the continuity of the base line.*)

3. Atmospheric-electric observations should be made to the extent possible with the observer's equipment and personnel at his disposal.

4. Meteorological observations in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that, at least, temperature be read every fifth minute (directly after the magnetic reading for that minute).

5. Observers in the belt of totality are requested to take the magnetic reading every thirty seconds during the interval, 10 minutes before and 10 minutes after the time of totality, and to read temperature also every thirty seconds, between the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal of *Terrestrial Magnetism and Atmospheric Electricity*.

LOUIS A. BAUER

WASHINGTON,
May 8, 1918

PROGRESSIVE DEGLACIATION AND THE AMELIORATION OF CLIMATE

IN SCIENCE of March 1, 1918,[1] Professor Mather criticizes the interpretation of the writer regarding the corroborating evidence of Antarctic deglaciation as being indicative of the amelioration of climate which has been a cumulative, although variable, process since the culmination of the Ice Age. This retreat of Antarctic glaciation is not the only record upon which the writer based his interpretation. He also used "the greater and still more impressive evidence of the comparatively recent uncovering of temperate land areas."[2] Professor Mather appears to dissent also from the opinions of Scott,[3] Shackleton,[4] Taylor,[5] Ferrar[6] and David.[7]

These authorities, with every other explorer of these regions, make especial mention of the marked extent of the deglaciation which has recorded its extent from "south pole to Antarctic circle" (David).

Professor Mather would also wait for observations extending over centuries and omits to make note of the progressive deglaciation of temperate latitudes which has legibly recorded itself for several hundred centuries, within which time the glacial lake beds of Canada have become one of the world's richest grain fields. This evidence is more impressive and conclusive than the vast evidences in Antarctica where "the ice is everywhere retreating" (Scott).

Nor do discussions as to whether this deglaciation is due to wet or dry glaciers or to a possible decrease in precipitation add anything of moment to the great facts pointing to an amelioration of the climate of the earth so that it "is now warmer than it was during the episodes of extensive glaciation characterizing the Pleistocene Ice Age," this being due to the rewarming under solar control inaugurated at the culmination of that age.

The writer does not agree with the idea that the present distribution and development of climates is "abnormal," but holds that it is in the orderly development of climates passing from the conditions of "geological climates" into those of solar control; and also holds that present climatic tendencies and zonal control no more point to a possible return to the nonzonal distribution and control of geological climates than the present developments of life point to a redevelopment of the extinct orders of life of previous ages.

As to the climatic influence of carbonic acid generated by the combustion of fuels, carbonic acid has two narrow bands of almost complete absorption in that part of the spectrum limiting the wave-lengths emitted by the earth. These bands are at 4.5μ and 14.7μ. The first is in a region of very slight terrestrial radiation and therefore unimportant; the second is in a region of strong vapor absorption and there is sufficient water vapor in the air to completely cover this field. Since "the efficiency of the water vapor is several times that

[1] "Diminution of the Antarctic Ice Cap and the Amelioration of Climate," SCIENCE, N. S., Vol. 47, No. 1200, pp. 218–19.

[7] *Geographical Journal*, Vol. XLIII., pp. 622–623.

[2] SCIENCE, N. S., Vol. 46, No. 1200, pp. 639–40.

[3] "The Voyage of the Discovery," Vol. II., pp. 416, 423, 424, 425. National Antarctic Expedition, 1900–1904, Vol. 1, p. 94. Scott's Last Expedition, Vol. II., p. 204.

[4] *Ib.*, pp. 286, 288.

[5] Address to Commonwealth Club, November 17, 1916.

[6] National Antarctic Expedition, Vol. I., 1900–1904, Report of H. T. Ferrar, A.M., F.G.S., geologist of the Expedition.

of the dioxide[8] there is little left in this restricted field as water vapor covers the whole range of terrestrial radiation very effectively. Abbot and Fowle, after very elaborate studies and observations and a review of the available data on the subject, sum up as follows:

> It therefore does not appear possible that the presence or absence, or increase or decrease, of the carbonic acid contents of the air are likely to appreciably influence the temperature of the earth's surface.[9]

There is no evidence showing that the temperatures of the depths of the Atlantic ocean are affected by the salter waters of the Mediterranean Sea. The temperatures of the depths of the Mediterranean Sea are controlled by that of the Atlantic at the depth of the sill of the Straits of Gibraltar, over which there is an inflow into the Mediterranean to replace evaporation and surface outflow less about 30 inches of precipitation. The temperatures of the depths of the Atlantic are controlled by those of polar waters.[10]

The area of the Mediterranean and tributary seas is about 1,149,000 square miles; of polar oceans down to the parallels of 60 degrees about 187,890,000 square miles. The relative influence of Mediterranean outflow upon abysmal depths of the Atlantic, according to the conclusions of Professors Chamberlin and Salisbury, is probably negligible.

MARSDEN MANSON

SAN FRANCISCO, CALIF.,
March 18, 1918

TRANSLATIONS MADE ACCESSIBLE

I READ with much interest in the last number of your paper a communication from Mr. Burling regarding translations of foreign literature. If anything is contemplated in the way of a central bureau we would submit for your information that the Technical Section of the Canadian Pulp and Paper Association and the Technical Association of the Pulp and Paper Industry (U. S.) through their committees on Abstracts are publishing each week in *Paper*, New York, and the *Pulp and Paper Magazine* of Canada, Montreal, abstracts of the literature relating to this industry.

These abstracts include reviews of articles appearing in American, Canadian, British and Scandinavian Journals relating to pulp and paper-making, lumber and forestry and will in time embrace those in other languages when such periodicals are again available. The committees are ready to loan original copies of the periodicals reviewed and to supply translations where they are desired.

You are probably aware that *Industrial Management* of New York has a similar department relating to engineering and similar topics and that their organization is also prepared to supply translations of such articles.

J. N. STEPHENSON,
Chairman Committee on Abstracts,
Technical Section, C. P. & P. A.

A NEW CALENDAR

ON April 16 Hon. J. M. C. Smith, of Michigan, introduced into Congress, at the request of Mr. C. W. Bennett of Coldwater, Michigan, a bill providing:

> That beginning with the year nineteen hundred and twenty each year shall have thirteen months of four weeks, or twenty-eight days each, the added month to be called Sol (from solstice) and to follow June.
>
> *Sec. 2.* That Monday shall be the first day of the week and the first, eighth, fifteenth and twenty-second days of every month; the other days of the week to follow in rotation by number, making Sunday the seventh day of the week and the seventh, fourteenth, twenty-first and twenty-eighth days of every month.
>
> *Sec. 3.* That the day following the last day of December, nineteen hundred and nineteen, and the last day of December in each subsequent year shall be called New Year Day. It shall be legal holiday, the first day of the new or following year, but not a part of January.
>
> *Sec. 4.* That in the year nineteen hundred and twenty and every fourth year thereafter shall be an extra day called Leap Day, to be placed between June and Sol, but not to be a part of either

[8] Chamberlain and Salisbury, "Geology," Vol. II., p. 672.

[9] *Ann. Astrophysical Obs. Smithsonian Institution*, Vol. II., pp. 172–73.

[10] Chamberlin and Salisbury, "Geology," Vol. II., 658–60.

month: *Provided*, That there shall be no Leap Day in the last year of any century that is not divisible by four.

A condensed statement of the facts relating to this calendar is as follows: The year consists of New Year's Day, which is the first day of the year, and is not a part of any week or month; and thirteen months of twenty-eight days each, as follows: January, February, March, April, May, June, Sol, July, August, September, October, November and December.

In centennial years divisible by 400 and in other years divisible by 4, an extra day, called Leap Day, is inserted between the months of June and Sol. Leap Day is not a part of any week or month. The first quarter of the year ends with the first week of April, the second quarter with the second week of Sol, the third with the third week of September, and the fourth with the fourth week of December. New Year's Day and Leap Day are holidays, and are omitted in counting interest and rent.

It might be an improvement in this calendar to have the week begin with Sunday, as has always been the case. The suggestion has also been made to give the extra month the name of Midyear, though these are matters of detail.

It appears to the writer that this calendar is more desirable than the one outlined by Professor Warren in the April 19 number of SCIENCE. I hope those who are interested in the matter will communicate with Congressman Smith and encourage him to push his laudable efforts in the matter.

W. J. SPILLMAN

DRAWINGS ON LANTERN SLIDES

TO THE EDITOR OF SCIENCE: In connection with the letter from Professor Gunthorp in your issue of April 12 in regard to drawings on lantern slides, I may mention that I have obtained satisfactory results with the use of ordinary India ink such as is used by draftsmen. This takes hold quite well on ordinary clean glass surface, I suppose through the action of the gum arabic contained in the ink. The slide can be attached to a drawing board by thumb tacks whose heads project over the glass, provided bits of rubber are placed between the glass and the heads of the tacks. For drawing circles with a compass a small bit of paper was gummed to the glass at the center, to enable the foot of the compass to take hold without slipping (the paper being afterward scraped off).

J. R. BENTON

SCIENTIFIC BOOKS

Culture and Ethnology. By ROBERT H. LOWIE, Ph.D., Associate Curator of Anthropology, American Museum of Natural History. New York, Douglas C. McMurtie. 1917.

Anthropologists in America need to issue more volumes for laymen than they have so far done. Dr. Lowie's present volume, and Dr. Wissler's larger volume on The American Indian, are especially welcome studies in this sparsely cultivated field.

Dr. Lowie says in his preface that his book is an attempt at popularization. Its aim is to occupy an intermediate position between technical discourses addressed to scientists and the more popular lectures which are designed to furnish mainly entertainment. In the first four chapters Dr. Lowie seems to me admirably to have attained his purpose.

The book starts with Tylor's well-known and practically perfect definition of culture: "Culture . . . is that complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society." The point is well made and forcibly driven home that since the science of psychology, even in its most modern and varied ramifications, "does not grapple with *acquired* mental traits nor with the influence of *society* on individual thought, feeling and will, there is need of a science which deals with all *acquired* capabilities and habits of man as a member of society." That science, as Dr. Lowie names it, is Ethnology.

In the discussion of "Culture and Race" the author grants that "at first blush" it appears very plausible that within the human species "differences in organization should be correlated with the observed cultural manifestations of varying degree and complexity." And he concludes that though we "assume that racial

differences *are* at the bottom of some of the observed cultural differences, this fact would not necessarily mean, then, that the *average* ability of the inferior races is less, but only that extreme variations of an advantageous character occur less frequently among them."

The field student of primitive peoples knows that not only do extreme advantageous variations occur less frequently among primitive peoples than among the more cultured groups numbering millions of men, but he knows that among primitive peoples artificial selection weeds out those superior individuals, who now and then appear and try to put over a new idea. The conclusion seems to me to be inevitable that this ruthless selection in time affects the racial hereditary abilities of such peoples—just as the Inquisition is known to have affected the Spaniards and Poles.

The author's conclusion in the chapter entitled "Culture and Environment" seems to me entirely too sweeping and to need many conditioning phrases:

"Environment can not explain culture because the identical environment is consistent with distinct cultures; because cultural traits persist from inertia in an unfavorable environment; because they do not develop where they would be of distinct advantage to a people; and because they may even disappear where one would least expect it on geographical principles." The discussion to a certain extent limits the sweeping reach of this conclusion.

In regard to "Determinants of Culture" Dr. Lowie truthfully says: "Psychology, social differences, geographical environment, have all proved inadequate for the interpretation of cultural phenomena. The inference is obvious. Culture is a thing *sui generis* which can be explained only in terms of itself." His conclusion is that culture is a closed system. Explanations of culture must remain on the cultural plane. "There are ultimate, irreducible facts, special functioning relations, and principles of wider scope that guide us through the chaotic maze of detail" in the science of human culture, as in all other sciences. Any particular cultural phenomenon is in a measure at least unique; and, in consequence, "its explanation will consist in referring it back to the particular circumstances that preceded it." One by one, then, cultural inventions must be studied primarily with reference solely to themselves; while the study of the growth of culture by diffusion from people to people, with accompanying modifications, will yield the larger volume of new data in the field of cultural research.

The last chapter, "Terms of Relationship," occupies eighty-two pages, or slightly less than one half the volume. By the time I had read the chapter two thirds through I turned to the conclusion for relief and light—and I was reassured of my powers of comprehension. This is Dr. Lowie's conclusion: "I am content with calling attention to the tremendous ethnological significance of kinship terminologies, with combating premature confidence in generalizations based on sheer ignorance, and above all with suggesting that the most rigorous logical formulation of problems is possible in this too long neglected domain of the science of culture." I was relieved to find that the often long-drawn arguments, the partial agreements with or refutations of, conclusions of other students of primitive culture, and the suggested relationships between kinship terminologies and cultural facts, were not intended to get the reader farther than Dr. Lowie's sane conclusion. I question the proper appearance of this chapter in a book intended primarily for laymen.

The book, on the whole, is a genuine asset to our anthropological literature, and will interest and enlighten the scientific student as well as the layman.

Albert Ernest Jenks
University of Minnesota

SPECIAL ARTICLES

NEZARA VIRIDULA AND KERNEL SPOT OF PECAN

The following is intended to serve merely as a preliminary note. The work to be done on the problem far exceeds what has been accomplished but the results obtained thus far are so striking that it has seemed worth while to

bring them to the attention of both entomologists and pathologists who might be interested.

Kernel spot has been reported by Rand[1] as a communicable disease. The same author isolated a fungus which he recorded as the causative agent, and described it as a new species (*Coniothyrium caryogenum* Rand). Otherwise little or nothing has been published on the disease. As the name implies, the disease affects only the kernel of the pecan and its presence can only be detected by removing the shell. The spot on the kernel is irregular in outline, dark brown or black in color and usually somewhat sunken. It varies from one eighth to one half inch in diameter. When the kernel is cut the brown area is found to extend into the meat to a depth of perhaps one eighth of an inch. The affected spot is bitter and imparts a bitter flavor to the rest of the meat.

The disease appears to be of general occurrence throughout the pecan belt, though ordinarily only a small percentage of the nuts are attacked. Occasionally, however, as in 1916, it becomes of very serious economic importance, causing the loss of thousands of dollars to the growers.

The green soldier bug, *Nezara viridula* (Linn.), is present throughout middle and southern Georgia, being of common occurrence every year and occasionally, as in 1916, becoming exceedingly numerous. The bug appears to attack cow peas in preference to all other plants, either cultivated or wild, when these are available. In the fall, when the pea vines begin to dry up, the bugs leave them and gather on any other plants or trees which they may find in the vicinity.

A very common practise among pecan growers is to sow peas in the groves during the early summer, the vines to be turned under, later, as a soiling crop. As a result, when the vines begin to dry up, usually in September or early October, the bugs leave them and collect on the pecans.

It was noticed, during 1916, that there occurred both a severe infestation of *Nezara viridula* and a severe outbreak of kernel spot. While it was entirely possible that this was a mere coincidence several growers noticed it, together with the fact that the disease appeared to be serious only in the groves in which cow peas had been sown. Moreover, in at least one case, bugs were observed feeding on the nuts.

As a result, during the past season preliminary experiments were conducted in which specimens of *Nezara viridula*, taken on cow peas, were confined on pecan nuts. The bugs fed on the green nuts, living on them for as much as a month, in three cases. Examinations made after the nuts had fully ripened showed that every nut in the several cages was severely infested with kernel spot, as many as five distinct spots occurring on a single kernel. Of several hundred nuts from the same tree, not confined in cages, only two or three had spotted kernels.

It has not been possible, thus far, to determine whether the fungus, *Coniothyrium caryogenum*, is present in the spotted areas, or not. In any case the data obtained are strongly indicative of the fact that *Nezara viridula* is an important agent in either the actual production or the dissemination of this disease. This is of particular interest since it is another of the observations, becoming more and more frequent during recent years, on the economic importance of a large group of insects (several families of the Heteroptera and the Cicadellidæ and Aphididæ among the Homoptera). Formerly these insects were recorded as injuring vegetation only when abundant, through the purely mechanical process of removing sap from the tissues. Of late, however, we are beginning to realize that many of them are of far greater importance than had been realized, both as the primary causative agents of specific plant maladies and as vectors and intermediaries in the dissemination of other specific maladies of bacterial or fungoid origin.

WILLIAM F. TURNER

GEORGIA STATE BOARD OF ENTOMOLOGY,
THOMASVILLE, GA.

[1] Rand, F. V., *Jour. of Agr. Res.*, Vol. 1 (1914), No. 4, pp. 330–334.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY. II

Preliminary report on experiments relating to continental deformation: R. T. Chamberlin and J. T. Richards.

The previous paper dealt with faulting, which may be regarded as a local, superficial phenomenon of continental masses; the present paper relates to the deformation of these greater masses. To attack this greater problem it seemed desirable to devise a mode of compressing blocks that have the shape of a continental sector of the earth with radial sides and superficial curvature. A machine for such sector crushing was built with movable steel jaws hinged below and corresponding in position to radii of the sphere. Into this a triangular wedge-like mass was molded with a surface curvature similar to that of a continent. By the use of a powerful jack, this representative of a continental sector could be squeezed by varying pressures reaching up to many hundreds of pounds per square inch. For experiments upon materials of uniform strength, pure paraffine was used; for experiments embodying the principle of increasing strength of materials with increasing depth below the surface in accordance with Dr. Adams's deductions from his experimental researches, there were molded, one above another in a series of zones of predetermined resistance, mixtures of plaster and paraffine in definite proportions. In all these experiments the prevalent type of faulting was that of a triangular wedge. This particular shape appears to be very significant, as has been suggested before. This wedge faulting naturally enough appeared first in the surficial portion of the sector; later after some relief had been realized above, and movement below had become less restrained, additional fracturing set in below. When paraffine alone was used, the numerous rough spots of the enclosing steel side-plates made trailing scratches on the soft material. These scratches served as autographic records of the different directions of internal movement of the material in reshaping itself into the separate wedges which came to divide the sector. As the scratches in many cases curved sharply, they indicated not only the various directions of movement of the separate portions of the sector, but also *the order of succession* of the individual movements that entered into the formation of each block. Further experimentation along these lines seems likely to throw some light upon the internal adjustments of masses within the earth while undergoing diastrophism.

Origin of the stylolitic structure in Tennessee marble: C. H. Gordon.

The marble known commercially as the Tennessee marble comes from what is known as the Holston formation, which is of Ordovician age. The producing areas occur chiefly in the central portions of the East Tennessee Valley region with Knoxville as a center. The marbles are sub-crystalline to more or less completely crystalline in texture and vary in color from light pink and gray to differing shades of red, dark chocolate and cedar. At the present time the light pink and gray are the leading varieties. One of the striking features of these marbles is the presence of thin, dark-colored interlocking seams or sutures known technically as stylolites. In the main these extend approximately parallel with the bedding or grain of the stone but not infrequently they are more or less inclined to this and at times cut the rock in all directions. The theories proposed to account for stylolitic structure are briefly considered and the solution theory accepted as being the most satisfactory. The chief question involved is as to whether these represent actual parting planes as heretofore usually considered, or fractures. It is the conclusion of the writer that while many of the sutures, especially in the more impure portions of the formation are undoubtedly parting planes, those in the massive light-colored stone have been formed along fractures instead of bedding planes. From the high content of carbonate of lime (98½–99 per cent.), the rich profusion of organic remains, chiefly bryozoa and crinoids, the irregularity in development, and certain features indicative of disturbed conditions in sedimentation, it is suggested that accumulation of the deposits took place in clear but shallow waters on reefs or banks where colonies of the types represented established themselves and grew in rich profusion. If reefs were present they were bryozoa reefs and not coral reefs, as no undoubted corals have been observed in the formation.

Report on the discovery of ancient glaciation on Mauna Kea, Hawaii: Wm. Alansen Bryan.

Reporting the discovery in July, 1916, of an ancient mountain glacial field fifty square miles in extent on the summit of Mauna Kea (13,825 feet), the highest mountain in the Pacific Ocean, together with an account of a subsequent ascent of Mauna Kea, Hualalei, and Mauna Loa for the purpose of securing comparative data for the determination of the relative age of these three important subtropical mountain summits.

Conditions of deposition of marine salts and their bearing on the potash problem: A. W. GRABAU.

The three theories which have been developed to explain the widespread occurrence of salt deposits in the past are: (1) The bar theory of Ochsenius. (2) The cut-off theory and, (3) the desert salt theory of Walther. (1) According to the first a constant supply of sea water is derived from the neighboring sea or large salt-water body. It is illustrated by the Karabugas Gulf. Such deposits are characterized by basal gypsum beds, an abundance of organic remains in the intercalated mud layers and by normal marine deposits of the same age in the neighboring sea from which the salt water was supplied. Mother liquor salts can only be developed as the result of a final cutting off of the basin and complete evaporation. (2) Salts deposited in a basin filled with normal sea water and cut-off from the sea, will be characterized by a basal gypsum or anhydrite layer, by an absence of organic remains except at the base, by the concentration of the salts into the deeper lying portion of the basin and by a regularity of the resulting series of salts. Such salt deposits may be enriched by additions from connate sources, with the result that the sodium chloride will be in excess of the other salts. Mother liquor salts are normally deposited in such a drying basin. The Stassfurt salts are believed to have had this origin. (3) Marine salts enclosed as connate sea water and salts, may be concentrated in desert basins far from the sea. They are characterized in general by the absence of a basal gypsum or anhydrite bed, though these salts may occur sporadically. Irregularity of deposition, lens-like character of the individual beds, and an absence of marine organic remains are among the other criteria of such a deposit. Moreover contemporary marine deposits are not necessarily formed in the immediate neighborhood of the salt basins. Mother liquor salts are generally and perhaps normally absent from such deposits, this applying especially to the potash salts which will be adsorbed by the soil through which the drainage waters pass before reaching the evaporation basin, while those that do reach this basin are apt to be dissipated as shown by Walther. The Salina salts of North America are believed to have had such an origin.

The Ordovician terranes of central Vermont: CHARLES H. RICHARDSON.

The author tersely gives the early geological history of central Vermont, from Algonkian time to the close of the Ordovician. He describes the Cambrian sedimentaries that flank the Ordovician on the west and form the eastern foot hills of the Green Mountains. The paper describes the Irasburg conglomerate which marks the base of the Ordovician terranes in central Vermont and the line of an erosional unconformity between the Cambrian and the Ordovician already followed for more than 100 miles in Canada and Vermont. It shows that the boulders in the conglomerate are all pre-Ordovician and the matrix Ordovician. The author then gives the general distribution of the three belts, non-continuous, of the Memphremagog slates, their composition and economic possibilities. This is followed by a description of the three belts of the Waits River limestone which are continuous and have been followed southward from the international boundary for 100 miles. These formations include the numerous beds of Waits River and Washington marbles which are catalogued as marble reserves. A short discussion is included of the intrusives in both the Cambrian and Ordovician terranes with a citation of about 20 different types of igneous rocks that have already been identified in these formations. The author lays stress upon the paleontology of the area because central and eastern Vermont were regarded as devoid of all fossil content prior to his discovery of numerous beds of graptolites in both the Memphremagog slates and the Waits River limestones. These graptolites have already been discovered in every township south of the international boundary near the central north and south line in the state for a distance of approximately 100 miles. They are present in each of the three phases of the Memphremagog slates and in each of the three phases of the Waits River limestone. Their presence proves sedimentation began in central Vermont in early Ordovician time (Beekmantown) and closed with the lower Trenton. The graptolites have been identified by Dr. Rudolf Ruedemann, State Paleontologist, Albany, N. Y.

Postglacial continental uplift: HERMAN L. FAIRCHILD.

The influence of the Ontario dome on the development of the Tertiary drainage of western New York, Ontario and Michigan: AMADEUS W. GRABAU.

The author has previously outlined the series of domes and basins which had their maximum development in eastern North America during the Appalachian revolution, but which had initial developments preceding that. The Paleozoic strata from which the cuesta topography of New York and Ontario was carved were not coastal plain strata to the Canadian shield as often assumed,

but had their source in the Appalachian Old-land on the southeast. Most of the limestones probably extended across the Ontario dome region which now shows only crystallines. These were exposed after the doming by the peneplanation which the region suffered in post-Paleozoic time. Renewed slight doming of this region in early Tertiary times caused the development of a cuesta topography which has no relations to the original oldland, indeed the cuestas point away from that oldland. These cuestas are in reality renewed hogbacks of the type developed around the Black Hills dome but the strata dip away from the center of the dome at a very low angle. The radial arrangements of the old river valleys now in part occupied by the Finger Lakes of New York and the Tertiary consequent streams of Ontario and Michigan further illustrate the effect of this dome.

The change of content of gasoline vapor in natural gas with age of the wells: O. J. SIEPLEIN.

Natural gas which has been in contact with petroleum has taken up gasoline vapors from the petroleum. These can be condensed by pressure or by use of solvents. Gasoline vapor is probably one hundred times as valuable as the same volume of gas. As the well-pressure decreases, a larger quantity of gasoline is associated with the gas. An increase of 0.07 in specific gravity means an increase of one gallon of liquid gasoline from a thousand cubic feet of raw gas. Pumping of old oil wells as gas wells makes it possible to extract a large quantity of gasoline from that petroleum which is retained by the oil-sands and is not to be recovered by ordinary methods of producing petroleum.

A large high-pressure carbon dioxide well: L. G. HUNTLEY AND ROSWELL H. JOHNSON.

The so-called "air blasts," a peculiar geological phenomenon in the Kolar gold field, India: E. S. MOORE.

The Kolar Gold Field, situated near Bangalore, Mysore, in southern India, has long been the most important gold-producing area of India. In this field a quartz vein carrying high values in gold to great depths, cuts a band of hornblende schists of pre-Cambrian age and these are in turn intruded by large dikes of basic igneous rock. Surrounding the area of schists and intruding it is a great mass of granite-gneiss resembling the Laurentian rocks of this continent. The "air blasts," which have received their name from the miners because of the rush of air which often accompanies large related disturbances, are explosions occurring in the walls of the workings on account of potential energy in the quartz, schist and dike rocks. This energy is permitted to act when mining operations relieve the pressure in certain directions. The source of this energy is believed to be found in the squeezing of the syncline of schist by the granite during compressional movements in the crust of the earth.

Pyrite in the coals of western Pennsylvania and its uses: HENRY LEIGHTON.

The enormous increase in the production of sulfuric acid since the war began, together with a curtailment of the importation of Spanish pyrite which, heretofore, was the source of 40 per cent. of the production, has brought about an earnest search for supplies in the United States. Among the sources of supply is the pyrite or marcasite occurring in coal beds as "sulphur balls." This material, during coal mining, is rarely saved, but if properly cleaned a good quality acid can be made from it. Among its good points is it freedom from injurious arsenic or phosphorus. By careful hand picking in the mine or on a picking table, much of this coarse material could be profitably saved under present conditions, while in washing coal for coke making, proper concentrating machinery could be installed for the recovery of a large amount of fine pyrite now wasted. An investigation of the pyrite resources of Pennsylvania is now being undertaken by the State Geologic Survey and indications are that much pyrite can be produced in the bituminous coal area, especially in the Pottsville and Allegheny series coals, around the north and northeastern margin of the bituminous field. Mercer, Jefferson, Clarion and Clearfield counties have in the past produced pyrite in small quantities and their production should be greatly increased.

Translations made accessible: LANCASTER D. BURLING.

By a system of reply postal cards, the request card of which enables a worker to inquire concerning the translation of any foreign paper in which he may be interested and of which he may be willing to share the expense if a special translation has to be made; the reply card properly filled out by the proposer of this scheme tells whether or not the paper sought has been translated, and if it has, where and how a copy may be obtained.

Factors determining the depth to salt water in wells: ROSWELL H. JOHNSON.

Problems in Green mountain geology: W. G. FOYE.

ROLLIN T. CHAMBERLIN,
Secretary

SCIENCE

Friday, May 24, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

SOME PROBLEMS OF NUTRITION IN THE ARMY[1]

Food has been defined as a well-tasting mixture of materials, which, when taken in proper quantity into the stomach, is capable of maintaining the body in any desired state. The choice of these mixtures in the form of menus, their preparation for the plate, their digestion and fate in the body, is the science of nutrition. If we had a complete knowledge of every food substance and the transformation it undergoes in the body; how it is prepared for usefulness, just what purpose it fulfils, how it fulfils this purpose and what becomes of it afterward—if we knew all this for every foodstuff; every class of substance we can use as food—we should have a *completed* science of nutrition.

A person is satisfactorily nourished when he is maintained in a physical and mental status—and we all know that food plays a part in maintaining mental as well as physical status—best fitted for the task he has to perform. We can begin now in view of the military situation in Europe to grasp the size of the task our army is destined to perform. What is the most desirable status, physical and mental, for our army? Very few of our soldiers have been in a fight, and none practically speaking, have lived the trench life—the life of the modern soldier. We have now under arms well on to a million and a half men who, six months ago, were leading peaceful pursuits—the majority of them, perhaps, sedentary, or at least unmuscular pursuits. In spite of

[1] Address delivered before the College of Physicians, Philadelphia, April 3, 1918.

the great part played by athletics in our national life, relatively few of our soldiers were athletes. The first requisite therefore was to create a body of well-muscled men. If you could see the great bodies of these men as I have seen them, you would agree that this aim is being rapidly achieved. The average soldier has gained both in weight and in height (a part of the latter is mere straightening up, but not all). Flabby muscle has given way to sinewy muscle. Fat has been reduced in many, and its place taken by active tissue. Such a change requires good food and, in the muscle-up period, a plentiful amount of muscle-forming materials, the best of which in the world is beef.

To gain a fighting spirit also requires good food—and plenty of it—to make the soldier contented, to make him feel well fed and "full of fight." This objective, also, I am sure, is being attained. Does any one grudge the soldier an abundance of food, even a little superabundance to be on the safe side, if these objects are being attained? I shall speak later of the element of waste which I know has been in your minds.

Army regulations define the ration as the allowance for subsistence of one man for one day. You will be interested in certain facts regarding the history of the ration as thus defined. The first legislation fixing the components of the army ration is dated November 4, 1775. The Continental Congress fixed at that time one pound of beef and one pound of bread as the allowance for each man per day, "3 pints of beans or peas at a price not to exceed $1.00 per bushel, one pint of milk, half a pound of rice or one pound of Indian meal per week, one quart of Spruce beer or cider for each man or nine gallons of molasses for each company of men per week." The ration also included candles and soap. The ration fixed July 16, 1798, is in some respects the same as we have to-day. At that time the allowance of beef was raised to 1¼ pounds or 20 ounces, the allowance of bread or flour to 18 ounces, rum, brandy or whiskey one gill, and the other items the same as in previous rations. In 1799 the issue of rum was placed at the discretion of the commander. In 1802 a provision was made for the conversion of strong liquors into wine and beer, otherwise the ration was the same as above. This ration continued through the War of 1812.

From time to time there was much controversy over the liquor component. In 1818 the following recommendation was made: "in a southern climate give molasses in lieu of whiskey or beer, and only one half pint of peas, beans or rice." Calhoun who was Secretary of War at this time, recommended that the liquor components of the ration be discontinued. This was concurred in by General Lovell, who was Surgeon General of the Army at that time. Congress, however, failed to act, and the liquor continued as a component of the ration until 1838.

During the War of 1812 there was much agitation on account of the failure of the contractor system. This system had prevailed previously, although much trouble had been experienced with it. In 1814 it broke down completely and the House of Representatives asked Monroe, then Secretary of War, for suggestions concerning a revision of the method of provisioning the army. A new system was worked out, but, peace having been signed with England, Congress adjourned and left the bill on the calendar. In 1817 the Seminole Indian outbreak in Georgia gave still another opportunity to show the weakness of the contractor system. Andrew Jackson, who was Commander of the Army, became so impatient with this system that he finally or-

ganized a commissary department for his own army entirely without authority from Congress and demonstrated that the army itself could handle the matter of supplies much better than outside contractors. This resulted in legislation dated April 11, 1818, which laid the foundations of our modern Subsistence Department. It should be explained here that the Subsistence or Commissary Department, which was separate and independent up to 1912, is now a part of the Quartermaster Corps.

The agitation for discontinuance of the liquor component in the ration came up at almost every session of Congress between 1812 and 1838. In 1832 coffee was for the first time made a part of the ration, and it was provided that six pounds of coffee and twelve pounds of sugar per 100 rations, that is, for one company of men, could be used in lieu of whiskey or rum at the rate of one gill a man each day. Nothing further was done with the army ration until 1856, when some agitation was started to increase the coffee and sugar components; after four years this modification was made, just before the outbreak of the Civil War. The ration which prevailed throughout the Civil War fixed by legislation dated August 30, 1861, was as follows:

Beef, 20 ounces,
Bread or flour, 22 ounces,
Potatoes, 16 ounces three times a week,
Beans, rice or hominy "in proportion with above."

Then for each company of men or 100 rations:

10 pounds coffee,
15 pounds sugar,
4 quarts vinegar,
4 pounds soap,
1½ pounds candles.

The peace-time ration, differing from the last named only in the absence of potatoes, beans, rice, hominy, etc., was returned to in 1865. These articles were restored by legislation dated 1892. Other minor changes were made which were continued in new legislation dated January 11, 1911. The "garrison ration," as it is known, as fixed by this last Act, is as follows:

20	ounces beef, or bacon 12 ounces,
18	ounces flour, or corn meal 20 ounces,
20	ounces potatoes,
2.4	ounces beans,
1.28	ounces prunes,
1.12	ounces coffee,
3.2	ounces sugar,
.32	gill syrup,
.50	ounce evaporated milk,
.50	ounce butter,
.64	ounce lard,
.16	gill vinegar,
.62	ounce salt,
.04	ounce pepper,
.014	ounce cinnamon,
.08	ounce baking powder,
.014	ounce flavoring extracts.

Besides this garrison ration, the American Army has three other rations. The *reserve ration* consists of hardtack or army bread, bacon, sugar, coffee, salt and pepper. This, according to regulations, forms the basis of field rations, but at the present time in France is being considerably modified according to the available supply. The so-called *travel ration* contains soft or hard bread, canned corned beef or corned beef hash instead of bacon, as in the reserve ration, baked beans, canned tomatoes, jam, coffee, sugar and evaporated milk. There is an allowance also for coffee already prepared when it can be obtained at railroad stations. The regulations provide for an *emergency ration* which has been well defined as simply "a substitute for nothing." This might also be called a tide-over ration. Many attempts have been made to concentrate into small space, so that it can be carried in the pack in a sealed parcel, the nec-

essary nutrients to maintain a soldier for twenty-four hours. The American Army has tried out half a dozen or more emergency rations but none of them have proved wholly successful. In conference with medical officers of the Navy and a representative of the Bureau of Home Economics of the Department of Agriculture, the Food Division of the Surgeon General's Office has reached the conclusion that no satisfactory emergency ration has yet been proposed and has taken the ground that the most satisfactory form of concentrated ration is hard bread supplemented by potted beef or ham, dried beef or sardines, and, when there is opportunity for the use of a portable cooker, three ounces of sliced bacon should be added.

Returning to the subject of the garrison ration, which forms the basis of feeding in all of our training camps, it should be explained that this ration as fixed by law does not prescribe what the men shall eat. It is merely used as the basis of the money allowance for the ration. A long list of substitutive articles is carried by the Quartermaster Corps, and the soldiers are allowed to eat anything they choose from this list, but they must not spend more than the amount of money represented by the cost of the garrison ration, with certain definite percentages of substitutions, at the time and place where they are stationed. For example, the value of the ration for this month at Washington Barracks is about 41 cents. This amount of money multiplied by the number of men in the organization is the amount which the mess sergeant may spend for food each day for his company. As a matter of fact, meat, bread and potatoes form the backbone of the ration now as always. The allowance of meat, 1¼ pounds including bone, for each man per day is purposely placed high, so as to cover all emergency requirements. The actual consumption of meat, as our food surveys have recently determined, is much lower than this. The average, I should say at this time, is not in excess of ¾ pound of meat for each soldier.

The list of substitutes makes provision for a considerable elasticity and variety in the diet. More than this, however, if the men do not like what the quartermaster has in store, they are at liberty to take money from the quartermaster in lieu of rations and buy materials outside. This is at the discretion of the commanding general. Where local market facilities are good, there is no objection to this method, provided the food supplied is carefully inspected. With an inexperienced mess sergeant, there is likely to be a waste of funds from this cause, but it sometimes happens that the local market is cheaper than the Quartermaster Department.

Let me now explain the actual workings of the mess system in vogue in our army. The soldiers are fed by companies or equivalents of companies, such as batteries of artillery, troops of cavalry, ambulance companies, field hospital companies, etc. According to the new tables of organization, an infantry company consists of 250 men. In the Civil War, remember, a company was only 100 men. Companies now, therefore, are practically the equivalent of battalions in those days, and a battalion of 1,000 men now is nearly the equivalent of the old regiment.

Each company in camps such as those now in existence in this country has an individual mess-hall with its appropriate kitchen equipment. When the cantonments were started, the company consisted of only 152 men, and some of the mess-halls were constructed on this basis, but they have since been enlarged in most camps, so that now it is possible to seat the entire company of 250 men at one time. The mess

conditions are under the supervision of a commissioned officer of the company designated by the captain and known as the mess officer. The purchasing agent of the company is a sergeant, known as the mess sergeant. It is his business to keep the mess accounts with the Quartermaster and to draw the rations for his organization. Staple articles, except meat and bread, which are issued every day, are drawn in "10"-day periods. This has been found by experience to be the most convenient period of time for a company. Each company has an adjoining store room which is supposed to be large enough to contain supplies for a 10-day period. At the beginning of this period the mess sergeant learns from the first sergeant of the company the number of men on the ration list. He multiplies this number by the value of the ration in money for the current month and multiplies this by ten to find the amount of his credit with the quartermaster for the ensuing period.

In conference with the company cook, the mess sergeant makes out menus for some days in advance and calculates the amount of each article required for the preparation of these menus. Such menus are supposed to be approved by the mess officer or the company commander and by some medical officer. You will be interested, I think, in knowing how these menus run. I quote from one for Company A, 301st Field Signal Battalion, November 5, 1917, at Camp Devens:

Breakfast

Oatmeal, milk and sugar,
Pork sausages,
Fried potatoes,
Bread and butter,
Coffee.

Dinner

Roast pork or roast beef,
Baked potatoes,
Bread and butter,
Cornstarch pudding,
Coffee, milk and sugar.

Supper

Beef stew,
Corn bread,
Karo,
Prunes,
Tea.

SUNDAY, NOVEMBER 4, 1917

Breakfast

Corn-meal mush, sugar and milk,
Hash,
Potatoes,
Bread and butter,
Karo,
Coffee.

DINNER

Roast pork,
Baked potatoes,
Celery,
Turnips,
Peas,
Cranberry sauce,
Mince pie,
Ice cream,
Cocoa.

Supper

Cold pork sandwiches,
American cheese,
Crackers,
Cocoa.

On the whole it must be said that the mess system in vogue in the American Army works well. Its weak points at this time are obviously the inexperience of the mess officer and the mess sergeant, the fact that good cooks are not available, and the absence of an adequate system of inspection. It was the realization of these weak points in our system together with the importance of conservation of our food re-

sources and the concern of the Surgeon General for the nutritional interests of the army, that led to the organization of the Food Division of his office. The object of this division might be expressed briefly in this way: to apply the science of nutrition to the problems of feeding the army. We wish to secure for the soldier perfect nutrition with the least possible waste of food. The government is not in the least niggardly with the army: indeed, we must not conserve to the point of denying the soldier anything he should have.

It should not be understood that it is the work of the Food Division of the Surgeon General's Office to supply food for the army. As already explained, this is done by the quartermaster. The Quartermaster Corps conducts practically all of the business of the army, and the quartermaster attached to the camp or to a tactical division is, so to say, the business agent of that unit. He purchases all the food, transports it and places it in storage at some place available for the camp or army. Upon requisition by the different organizations, he issues the food, as already explained, and carries in stock the entire list of articles prescribed in the garrison ration and in the list of substitutes. He may also have what is known as a "Sales Department" which contains a considerably wider range than the list of substitutes. For example, the patent breakfast foods—Post Toasties, Puffed Wheat, Puffed Rice, and other package foods—can be purchased through this sales department.

The work of the Food Division is largely of an advisory or inspectorial nature. We have been authorized now by the Secretary of War to do three things: First, to inspect all the food of a camp with reference especially to its nutritive value; Second, to seek to improve the mess conditions (cooking and serving of the food) to the end that a properly balanced menu will be employed and the food served in palatable form; third, to determine the actual consumption of the food and the amount of waste and report these facts to the Division Commander. The division contains now 65 officers and some 50 enlisted men. A Nutritional Survey Party, as it is called, consists of four officers and several enlisted men. This party visits a camp and spends from two to four weeks studying food conditions and making recommendations through the chief surgeon to the commanding officer of the camp. We have nine such parties operating at the present moment. Each party makes a tour of from four to six camps and then goes back over the same ground to observe especially what improvements have been made.

A first contingent of six officers under the leadership of Major Philip A. Shaffer, dean of the medical department of Washington University, has gone abroad to report to General Pershing for similar service in France. Their duties will be to aid in proper nutrition and messing of troops and supervising the conservation of food so that it shall be consistent with adequate feeding of soldiers in campaigns.

Already the Food Division has been able to improve food conditions in a considerable number of camps. Our officers have caught at the subsistence stores spoiled meats and spoiled canned goods and have condemned them. They have suggested improvements in mess arrangements, in menus, and have given systematic instruction to the mess officers and mess sergeants in food values and the proper uses of foods. In many instances their recommendations, having the full force of recommendations from the Surgeon General himself, have been adopted without question. In addition, we have already gathered a considerable body of information regarding the ac-

tual consumption of food and the amount of waste.

to stock during the period, and third, an inventory at the end of the period. The

TABLE I

Page from Statistical Report of Food Consumption in the Training Camps.

	Food per Man per Day: Nutrients	Supplied	Wasted	Consumed	Consumed Distr. of Fuel Value, Per Cent.	Wasted, Per Cent.	Per Man per Day
Camp Travis							
0042 90th Div., Caisson No. 1, 11/7–13/17	Protein, gm.	117	15	102	14	13	Consumed cost, 37 c.
	Fat, gm.	101	18	83	25	18	Waste cost, 5 c.
	Carbohydrate, gm.	519	54	465	61	10	Total waste, .50 lb.
	Fuel value, cal.	3,547	450	3,097	100	13	Edible waste, .22 lb.
0043 90th Div., Co. A, 357 Inf., 11/8–14/17	Protein, gm.	135	5	130	13	4	Consumed cost, 37 c.
	Fat, gm.	185	6	179	40	3	Waste cost, 1 c.
	Carbohydrate, gm.	505	16	489	47	3	Total waste, .50 lb.
	Fuel value, cal.	4,345	142	4,203	100	3	Edible waste, .15 lb.
0044 90th Div., Co. B, 357 Inf., 11/8–14/17	Protein, gm.	85	3	82	15	4	Consumed cost, 31 c.
	Fat, gm.	68	3	65	26	4	Waste cost, 1 c.
	Carbohydrate, gm.	346	10	336	59	3	Total waste, .37 lb.
	Fuel value, cal.	2,399	81	2,318	100	3	Edible waste, .13 lb.
Ft. Sam Houston							
0040 Base Hosp. Det. Mess, 11/4–10/17	Protein, gm.	112	4	108	17	4	Consumed cost, 40 c.
	Fat, gm.	105	6	99	34	6	Waste cost, 2 c.
	Carbohydrate, gm.	333	12	321	49	4	Total waste, .36 lb.
	Fuel value, cal.	2,801	121	2,680	100	4	Edible waste, .19 lb.
Wadsworth							
0068 27th Div., Bat. E, 106 FA, 12/5–11/17	Protein, gm.	170	4	166	16	2	Consumed cost, 49 c.
	Fat, gm.	187	7	180	38	4	Waste cost, 2 c.
	Carbohydrate, gm.	507	15	492	46	3	Total waste, .82 lb.
	Fuel value, cal.	4,515	143	4,372	100	3	Edible waste, .46 lb.
0069 27th Div., Co. I, 12 NY Inf., 12/6–13/7	Protein, gm.	151	8	143	14	5	Consumed cost, 42 c.
	Fat, gm.	126	5	121	26	4	Waste cost, 3 c.
	Carbohydrate, gm.	674	42	632	60	6	Total waste, .95 lb.
	Fuel value, cal.	4,554	252	4,302	100	6	Edible waste, .68 lb.
0070 27th Div., Co. I, 106 Inf., 12/6–12/17	Protein, gm.	118	9	109	14	8	Consumed cost, 36 c.
	Fat, gm.	89	4	85	25	4	Waste cost, 3 c.
	Carbohydrate, gm.	516	38	478	61	7	Total waste, .90 lb.
	Fuel value, cal.	3,428	230	3,198	100	7	Edible waste, .58 lb.

The accompanying table shows one page out of our statistical report of actual feeding conditions in individual mess houses (Table I.). As shown on this page, in three messes in Camp Travis, Fort Sam Houston, Texas, and base hospital mess and three messes at Camp Wadsworth, Spartanburg, South Carolina, the food consumption is expressed on the man-per-day basis. This is obtained by first making an inventory of the amount of food on hand in the company storehouse, at the beginning of a definite period, second, a list of accessions second inventory subtracted from the sum of the first, plus accession to stock gives the amount of food used. Concurrently with this, the garbage is separated into several cans, one for spent bone, one for peel and other inedible refuse such as coffee grounds, egg shells and the like, and one for table or edible waste. This last fraction is weighed, sampled and analyzed. The total nutrients contained in the edible waste subtracted from the total nutrients contained in the food as supplied, gives the actual consumption of food. This table gives a good idea

of the very high variation of food consumption, ranging as noted from 2,300 to 4,300 calories per man per day. One reason for this large variation is the availability of extra foods at camp exchanges and adjacent restaurants. The table shows also a high variation in the amount of waste and is fairly typical of the difference we have found between the National Army Camps and the National Guard Camps. This difference is largely due to the fact that, in the National Army Camps, schools for cooks and bakers have been in operation from the very beginning and at the time these surveys were made, the cooks in the National Army Camps, although having had only a couple of months' experience, were already much more efficient than the cooks in the National Guard Camps who had not received instruction in such schools. It should be stated, however, that the National Army Camps are much better equipped as regards their kitchens, they have better ranges, better storehouses and more conveniently arranged mess halls than have the National Guard Camps.

The general public is naturally very much interested in this matter of waste. Numerous reports from civilians who have visited the camps have reached our office to the effect that there is gross and wanton waste of food. These observations, as a rule, are purely casual, and in many instances, at least, are incorrect. In the construction period of the camps, the construction contractor was responsible for a great deal of the visible waste of food. The ordinary civilian visiting such a camp and seeing evidence of waste did not distinguish between the civilian contractor and the army. Whole heads of cabbage, whole potatoes, spoiled hams, joints of beef, etc., could be seen in the garbage pails, in the garbage wagons, or garbage cans, and a hasty conclusion was reached that the army was thus wasting food. Our officers have now visited all of the large military camps, numbering altogether in the neighborhood of forty. They have very rarely seen in any of the camps any such evidence of waste as reported in these private letters, which unfortunately have found their way to the public press. It is a great exception to see whole potatoes or large pieces of bread, or bones with meat attached in any considerable amount in any of the garbage cans from the army mess houses. I have personally visited 22 camps, and have looked into thousands of garbage cans, and bear witness that in the great majority of these cans one does not see more waste proportionately than can be seen in the garbage of an ordinary household.

We have recently had reports from Camp Funston and Camp Sevier which show that the waste has been reduced to such a point that it is practically negligible. For example, in one mess house in Camp Funston where more than 200 men were fed, the total edible waste from three meals was only six ounces; at Camp Sevier the report of our party working there at the present time is that, in a considerable number of mess houses, the total waste from a meal is not over one half pound. This means satisfactory discipline and, especially, it means inspection of plates at the end of the meal. Conservation has been made a subject of division orders in these camps and others, the instructions being that men shall not take on their plates more than they can eat, violation of this order being made a cause for punishment. Company commanders at their discretion can compel a man to eat at the next meal anything he has left on his plate. It means also satisfactory serving arrangements. It has been the experience of our officers that the most economical way of serving men in large numbers is by what we call the squad system. If possible, men

should be seated by squads and should be served by their own squad leader. The essence of the system is, however, that the squad leader shall have authority over the serving of his men. He either serves the food himself on their plates or at least sees to it that no man takes more food than he can eat, and reports him if he does.

It should be remembered that these company households are still very young. None of them in the National Army are more than six months old. To take a body of 250 men at random from the civilian population and train them in six months in the handling of this large quantity of food, so that there should be no undue waste, is indeed a fine accomplishment.

Many problems are arising constantly in connection with our work. We were faced at the start with the fact that there is very little exact information on the amount of food required by the army in training or in the field. Such information as exists is obtained from the record of purchases in the Quartermaster Corps, or the corresponding departments of other armies, and not from the estimation of food consumed directly. We have, I believe, the first instance in the history of warfare, where the actual amount of food consumed is estimated directly in the camp and in the field where the troops are operating. This is made possible by our system of feeding men by companies. In this way, it is possible to check up closely also on the relative cost of the different foods. We find, for example, that where more meat is used the cost of the ration is always higher. Meat, so far as we can learn yet, represents the most expensive article of diet, but meat is also one of the most important articles of food, especially for soldiers in the muscling-up period of their training. Experiments by Thomas and others show that the nitrogenous waste of the body is most readily replaced by the nitrogenous constituents of meat. Meat, then, is the most economical repair material for muscle and other active tissues. Next to meat comes the protein of milk and eggs, and below these the proteins of cereals, legumes, beans, peas, etc. It has been proposed by Professor Lusk to call these most economical proteins, proteins of Class A, meaning that they are most valuable for the purpose of repair and restoration of tissue, and hence also for the growth of tissue, in the whole list of food stuffs.

We were faced also at the beginning with the question of what should be the optimum amount of protein in the ration. Authorities now generally agree that muscular work does not involve a breakdown of muscle tissue, rather the contrary. A man who has not been accustomed to work, when he begins actual muscular exercise instead of breaking down muscle will build up muscle and it has been abundantly proved by numerous experiments that the breakdown of nitrogenous material in the body does not increase in muscular work over the amount broken down in complete muscular rest. This is a surprising fact, but it is now quite incontrovertible. Muscular work is done at the expense of potential energy in the form of carbohydrate and fat. There is much evidence also that this energy can be derived most economically from carbohydrate food, especially from sugar, and this doubtless explains the craving of men in muscular training for sweets. These facts would indicate that a relatively small amount of protein or meat in the diet would be sufficient for muscular work. It is quite possible that our soldiers could get along with considerably less than they are using, although our investigations show that they are actually using much less than the government allowance. There are some facts, however, which deter us at present from

recommending a radical reduction in the amount of meat in the ration. First of all is the fact that meat stimulates heat production in the body more than any other food stuff, and therefore assists in keeping the body warm in severe weather. There is some evidence that for a quick delivery of maximum energy, such as may be necessary in getting "over the top," a high protein diet is necessary. We certainly desire that the American soldier shall have plenty of "punch" to his fight, and if a high protein diet will insure this punch, nobody, I am sure, will grudge him all the meat he feels like eating.

United States rations, both for ordinary encampment training and for field uses. The British field ration is the ration used in the training camps in France. When the men go into the trenches or engage in active operations, this is supplemented by the addition of pea soup, butter and sugar amounting to 300–500 calories. The Canadian diet No. 40 is taken from an actual weekly diet sheet as used in the Canadian training camps in England last September. The French normal ration is the training ration, the reserve ration corresponds very closely to our own reserve ration and their strong ration is their campaign ration.

TABLE II

Comparison of Allies' Rations

Ration	Weight				Fuel Value				Distribution		
	Total	Protein	Fat	Carbohydrates	Protein	Fat	Carbohydrates	Total	Protein	Fat	Carbohydrates
	Gm.	Gm.	Gm.	Gm.	Cal.	Cal.	Cal.	Cal.	%	%	%
British Field	1,461	143	154	440	586	1,432	1,804	3,822	15.3	37.5	47.2
British Field and Trench	1,893	144	174	463	590	1,618	1,898	4,106	14.3	39.4	46.3
Canadian, Oct. 1, 1917	1,860	151	182	460	619	1,693	1,886	4,198	14.7	40.3	45.0
Canadian Diet No. 40	622	132	127	363	541	1,181	1,488	3,210	16.9	36.8	46.3
French, Normal	1,261	141	89	467	578	828	1,915	3,321	17.4	24.9	57.7
French, Reserve	1,091	112	114	385	460	1,063	1,580	3,103	14.8	34.3	50.9
French, Strong	1,302	152	97	509	623	902	2,087	3,612	17.2	25.0	57.8
Italian Combating	1,366	142	67	519	582	623	2,128	3,333	17.5	18.7	63.8
Italian Territorial	1,116	94	50	415	385	465	1,701	2,551	15.1	18.2	66.7
U. S. Garrison	1,935	175	125	671	718	1,163	2,751	4,632	15.5	25.1	59.4
U. S. Garrison, Modified	1,803	166	178	657	681	1,655	2,694	4,809	13.5	32.9	53.6
Average, 87 messes	1,940	139	130	536	570	1,209	2,198	3,997	14.3	30.4	55.3

Other armies are getting along on less meat than allowed by the government to our army. The British army allows 1 pound per man per day, the French army ¾ pound, the Italian army only ½ pound. Our allowance, you will remember, is 1¼ pounds, but the actual consumption by our army up to the present time in the camps in this country does not exceed ¾ pound. It would therefore seem that ¾ pound of meat provides a sufficiency of protein of this class.

Table II. exhibits a comparison of the British, Canadian, French, Italian and United States rations (continued above)

Corresponding rations for the Italian army are the territorial and combating rations. The United States garrison ration as laid down by the regulations, provides as shown here 4,632 calories per man per day. When, however, this ration is made the basis of money allowance, certain substitutes are made, for example, 30 per cent. of meat is issued as bacon, 20 per cent. of the allowance for potatoes is issued as onions, and 10 per cent. as tomatoes. With these substitutes made throughout, the garrison ration, "modified" as we call it, provides 4,809 calories. Now, the average con-

sumption in the training camps as shown by our surveys is to date just a little less than 4,000 calories. On this diet, supplemented of course by a certain consumption of food from the camp exchanges, the men have gained in weight on an average of about 9 pounds since entering the training camps. Some organizations even show an average gain of as much as 20 pounds, others only 2 or 3 pounds, but the average throughout the army, according to the best information we can obtain to-day, is in the neighborhood of 9 pounds per man. Compare with this army ration, the average consumption of food as shown by recent family dietary studies made by the Bureau of Home Economics under Dr. Langworthy at the Department of Agriculture (Table III.).[2] Note that the consumption of food per man per day in farmers' families is quite similar to that as already shown for the average allied soldier in training. The work of the soldier in training, therefore, so far as its intensity is concerned, may be closely compared with the work of a farmer. According to an article published recently in *Nature*, the average consumption of food among the English munition workers for 1917 where more than 18,000 observations were taken, is 3,463 calories. Summarizing again, we may say the average American farmer uses about 3,500 calories, the average English munition worker very nearly the same, the average soldier of the Allies, considering British, Canadian, French, Italian and American forces, in training camps about the same amount and in actual campaigns some 500 calories more.

TABLE III

Family Dietary Studies

	No. of Fam.	Average Income	Days per "Man"[3]	Cost	Per "Man" [per] Day			
					Protein, Gm.	Fat, Gm.	Carbo., Gm.	Calories
Garment makers	7	$ 724	168	.38	109	80	494	3,130
Professional men	17	2,208	434	.564	99	149	438	3,490
Teachers	32	2,150	620	.473	88	126	428	3,200
Farmers	12		384	.436	101	130	503	3,585
Engineers (professional)	5	2,252	97	.526	85	124	395	3,035
Laborers	6	1,497	205	.35	94	102	481	3,220
Salesmen	5	2,527	121	.449	88	111	405	2,970
Mechanics	10	1,303	309	.44	95	113	444	3,175
Mother wage earners	12	923	326	.33	105	66	440	2,955
Retired	5	1,647	130	.48	81	121	420	3,095
Clerks	11	1,934	225	.50	90	119	417	3,040
Weighted averages	122	1,799[4]	3,019	.438	94	117	438	3,180

Another problem in which we have been greatly interested is whether the soldiers should be given all the sweets they crave. Our survey parties in the military camps have determined the actual consumption of food from the exchanges or "canteens," as they used to be called, as well as from the mess house. In one camp where there was but a single exchange, it was possible to determine the average consumption with a high degree of accuracy. In these canteens or regimental exchanges, the foods which are bought by the soldiers are for the most part candies and light drinks (the food value of which is represented entirely by a

[2] Through Dr. Langworthy's courtesy I am permitted to show these figures for the first time.

[3] "Man" = all members of the family reduced to the basis of men.

[4] Average 110 families.

syrup), cakes, pies, ice cream, etc., in other words, articles of food which would be classified as sweets. In this particular camp it was found that the average soldier bought in the neighborhood of 500 calories of energy every day in the form of sweets. This represents fairly typical conditions. Wherever it has been possible to estimate with any degree of accuracy at all the consumption of food from these exchanges, we have found figures ranging in the neighborhood of those just quoted. We may say, then, that the average soldier craves in the form of sweets, which represent quick energy in much the same way that alcohol in small quantity represents quick energy for the body, food amounting to about one eighth of his total daily requirements. The question may fairly be asked whether the government would not be well advised to reduce the quota of meat and replace the amount thus saved with sweets, provided as a part of the ration.

Still another question of great interest, not only for the army but for the entire civilian population, is the question of dehydrated vegetables. As a means of preservation and therefore of conservation of our food supply, dehydration or drying has already proved its place. By means of improved appliances, this measure may now be extended to classes of food stuffs not ordinarily preserved by drying. Potatoes, cabbage, spinach, strawberries and many other articles usually preserved by other means may now be dehydrated much more effectively than by ordinary means of drying, and may be preserved in this dehydrated condition for a considerable length of time, if not indefinitely. The importance of this measure for the army lies in the saving of tonnage or cargo space in transportation of food materials across the country and across the water. Major Samuel C. Prescott, of the Food Division, has prepared an exhaustive report on the subject of dehydration covering all phases of the subject from the saving in the space to the chemical composition and microbiology of the product. Immediately after this report was submitted to the Quartermaster Department, that department began placing orders for dehydrated vegetables such as potatoes, onions and carrots for the use of General Pershing's army. As yet the tonnage contracted for is not large, but in all probability in the very near future dehydrated vegetables will become a staple article in our army rations, as they have already become in the ration of the British army. Thousands of tons of dehydrated vegetables are being prepared in Canada, some also in the United States for the British army. By simply soaking in water and boiling in the same water, these vegetables are brought back to the condition of fresh vegetables so perfectly that very often they can not be distinguished from the fresh vegetables themselves. Another advantage of such products is the very high saving of time in the company kitchen. Dehydrated vegetables put up in packages are ready for the kettle; this saves the work of one or two men a day.

It is fairly safe to predict that before very long methods will be found for the dehydration of meat as have already been found for the dehydration of milk. Such measures remove many dangers of food poisoning. Meat spoilage is almost entirely due to imperfect refrigeration, but if the water is taken out of the meat, it does not need to be refrigerated. Bacteria can not grow without water. The Food Division through investigation made at the Harriman Research Laboratory in New York, has already found a satisfactory method of making meat powder, by dehydration at low temperature and a high vacuum. This can be used as a component of soup

stock or dried hash which requires only a short soaking in water and boiling to make a very delicious dish. The Bureau of Chemistry under the direction of Dr. Alsberg is also working on this problem, as is also the Bureau of Animal Industry under Dr. Mohler. There should be, as a result of these studies, in time a very large saving in the cost of living. Imagine the difference in the cost of transportation of milk with and without its water content, quite aside from the saving in the cost of refrigeration. Milk is 88 per cent. water, meat is about 70 per cent. water. Practically all of the water can be extracted from milk, leaving a powder which will go into solution readily and, by combining with sweet butter, can be turned out as a product of any desired composition. Already it is possible to deliver milk of this kind, which at current retail prices costs 14 cents a quart, for less than 9 cents a quart. There should be a corresponding saving in the cost of meat, for two of the largest factors in the cost of meat to-day are refrigeration and freight charges. In the case of milk, the reconstituted article is just as palatable as the original milk and is very much safer, for it can be pasteurized twice, once just before powdering, and again just after reconstitution with little extra cost. In the case of meat in the form of soup stock, hash and stew, which form the bulk of meat consumption in the army, the product again is just as palatable as the original meat.

There are many other aspects of the problem of nutrition of the army which would interest you had I the time to take them up in detail. One of the most interesting to us in the office has been the preparation of some special rations for the use of our own American prisoners in Germany and for the use of sick soldiers and prisoners. One of the first things the Food Division was asked to do after its organization early in September was the preparation of an American Prisoners' ration. This request came from the American Red Cross, and after a few days we had prepared for them a ration which could be shipped in bulk to the Red Cross Headquarters at Berne, Switzerland, and packed in parcels not to exceed 11 pounds in weight, according to the specifications required by the German government, and sent three times every two weeks to the American prisoners held in Germany. It was our task to see that such a parcel contained enough food value for the American prisoner to last him until the next parcel should be due to arrive. Articles had to be selected which could be packed in small cartons, and which would be certain to keep for the necessary length of time. These articles also had to be such as could be prepared readily for eating under the limited facilities of the prison camp. The list as finally made up runs somewhat as follows: rice, sugar, dried beef, pork and beans, peanut butter, soda crackers, evaporated milk, milk chocolate, desiccated strawberry, jam, nutmargarine and dried figs. Provision was also made for variation and substitution such as tea for coffee, marmalade for jam, oleo for nutmargarine, dried apples, apricots, etc., for dried figs, hominy for rice, corned beef for dried beef, etc. I think we may all feel comforted by the thought that if an American soldier is taken prisoner, he will, by this beneficent arrangement of the Red Cross, at least be well fed. Information which seems to be perfectly reliable from the Red Cross representatives at Berne assures us that the British provisions for their soldiers, which are quite similar to ours, are not interfered with, in any way, by the German government at the present time.

The requirements of the sick soldier are very different from those of the healthy

soldier. Considerably more latitude is required in the selection of foods which may tempt the appetite of the soldier, if ill in bed. The realization of these facts led to another request from the Red Cross for a ration to be known as the Invalid Ration. This was designed in the first instance for American prisoners in Germany too ill to be out of bed, but it has been thought that the same ration could be used also by sick soldiers in our own hospitals in this country. This ration therefore has been constructed with the idea that it could be used by sick soldiers anywhere in our own service, or in the prison camp. The ration has been approved by the President and adopted. It follows: unpolished rice, yellow cornmeal, sugar, potted chicken, Julienne or compressed soup tablets, dried milk powder of malted milk, beef extract, minute tapioca or other form of prepared pudding crackers, tea, milk chocolate, marmalade, fresh fruit or fruit juice. These articles, however, are regarded as only supplementary to those of the regular ration, whether prisoners' ration or the garrison ration.

It is comforting just now to remember that the status of the science of nutrition in America is fully equal to its status in the land of our enemies at the beginning of the war. If we fail in the trial that is upon us, it will not be for lack of information. If we fail to keep our civilian population properly nourished, it will not be because we do not know the functions of food, or because we do not know what foods are suitable. Likewise with the army.

Our own government has been foremost in the support of scientific investigations along these lines. The names of Atwater, Chittenden, Lusk, Benedict, Mendel, Osborne, Taylor, McCollum, Alsberg, Armsby are known wherever the science of nutrition is studied, and the completeness of their work is openly admired and envied in England, France, Scandinavia, and even in Germany. Immediately preceding the outbreak of the war, no less than a dozen young German investigators of promise had studied in American laboratories, because the work of several of these laboratories was considerably in advance of similar laboratories in Germany or Austria. The support of these laboratories by the national government, by state governments, and by our wealthy benefactors, Carnegie, Rockefeller, Mrs. Sage and others was responsible for their splendid equipment. But the leadership also was not lacking. In fact, the scientific leadership pointed the way to the benefactions and governmental appropriations.

JOHN R. MURLIN

FOOD DIVISION,
SURGEON-GENERAL'S OFFICE,
WASHINGTON, D. C.

ICELAND SPAR IN MONTANA

THE existence of large deposits of pure calcite has recently been brought to the attention of the Bureau of Mines. These deposits occur near Gray Cliff, Montana, and have been inspected by Dr. S. C. Lind, of the Bureau. At the present time there is no considerable market for pure calcite. It is used for the manufacture of some kinds of glass. Perfect crystals of calcite are used in certain optical instruments. In the past practically all the optical material has been mined from one deposit in Iceland. The crystals from the Montana deposit appear to be the nearest approach to Iceland spar yet uncovered in any part of the world.

Since the seventeenth century science requirements for optically perfect calcite have been supplied almost wholly from the well-known but small deposit on the east coast of Iceland. This is a very remarkable occurrence, consisting of a cavity in basalt completely filled with enormous crystals of pure calcite. Rhombohedrons and scalenohehedrons with diameters as great as three feet have not been uncommon. In recent years, however, the

difficulty in securing first class spar from the Iceland deposit has steadily increased, much of the material taken out being useless for optical purposes.

Occasional finds of doubly refracting spar have been made elsewhere without resulting in the development of a new supply.

While the total amount of spar required is not great, the maintenance of a certain production is necessary for the manufacture of Nicols prisms to be used in dichroscopes for testing pleochroism of gem stones, polariscopes, polarizing microscopes and saccharimeters. Other substances having as great a difference in the refractive indices of the ordinary and extraordinary rays are all unsuitable for replacing Iceland spar in optical instruments.

It is possible that the Montana veins might be made to return a commercial product of spar if they were worked with sufficient care. From one vein six hundred pounds of crystals are said to have been shipped to an agent who sold the spar in Germany, receiving $3,000 therefor. These crystals had been sorted from thirty to forty tons of calcite blasted out in the sinking of a seventy-five-foot shaft.

The Montana deposit lies in two vertical veins in gneiss. The veins are four to seven feet wide, probably at least 100 feet deep, and are several miles long. The deposits are near the surface, easily mined, and quite accessible to the railroad. The crystals practically fill the entire vein without any admixture of foreign intrusions.

So far, no absolutely perfect crystals have been obtained from these veins, but it is altogether likely that a better product may be had by more careful mining. The imperfections are of two kinds. Some crystals have a very slight, gray cloudiness, which renders them unsuitable for optical purposes. This defect is inherent. The bulk of the material, however, while perfectly clear shows slight cleavage in the interior of the crystals. This may be and probably is due to the shocks to which the crystals are subjected in mining.

Some of the crystals were obtained by the Bureau of Mines and submitted to the Bureau of Standards for test. Their report is quoted below.

> The larger sample does show interference colors in places in its body as noted by ———. We are not, however, of the opinion that this renders the whole crystal useless for optical purposes. It would appear that good material for small optical parts (*e. g.*, small Nicols prisms) might be cut from this crystal.
>
> It is also true that the smaller sample is very slightly turbid (milky). This makes it not strictly first class, but for some purposes would not impair its use. Otherwise it is an exquisite sample. We would like to have for our own use a considerable supply of material.

If a market could be developed for pure calcite to pay for mining a large tonnage of these deposits, it appears altogether probable that good optical crystals could be obtained as a by-product in quantity sufficient for all scientific requirements, and so meet the need caused by the diminishing output from Iceland.

CHAS. L. PARSONS

BUREAU OF MINES,
WASHINGTON

SCIENTIFIC EVENTS

INVENTIONS SECTION OF THE GENERAL STAFF OF THE DEPARTMENT OF WAR

THE following statement is authorized by the War Department:

In order to secure prompt and thorough investigation of inventions submitted to the War Department an "Inventions Section" has been created as an agency within the General Staff. All inventions of a mechanical, electrical, or chemical nature submitted to the War Department for inspection, test, or sale are now considered by this section.

Inventions may be sent by mail or may be submitted in person, accompanied by written descriptions or drawings. They go first to an examining board having technical knowledge of the classes of inventions they handle, whose investigations determine whether the inventions have merit. Those with merit are referred to the Advisory Board, which determines in each case whether it should be put in the hands of some of the numerous testing and

developing agencies, or if it should go to one of the staff or supply departments for test and consideration of its adoption, and final acquirement of title if such action is desirable.

Composing the Advisory Board at present are the following: D. W. Brunton, member Naval Consulting Board and chairman War Committee of Technical Societies; Dr. Graham Edgar, member National Research Council; Colonel James W. Furlow, Quartermaster Department, chief of Motors Division; Colonel J. A. Hornsby, M.C., chief of Hospital Division, Surgeon General's Office; Lieutenant Colonel Morgan L. Brett, Ordnance Department, Engineering Branch; Lieutenant Colonel Robert A. Millikan, S.C., chief of Science and Research Division; Lieutenant Colonel N. H. Slaughter, S.C., chief of Radio Development Section; Major Joseph A. Mauborgne, S.C., chief of Electrical Engineering Section.

When completed the board will have 12 to 15 members to cover fully all of the various technical problems which may come before it.

In testing and developing inventions and in considering problems presented by staff departments, the Advisory Board works in connection with a number of agencies. Among them are the following: National Research Council; Bureau of Standards; War Committee of National Technical Societies (this committee consists of two members detailed from each of the 10 important technical societies in the United States); laboratories and shops of the staff and supply departments of the Army; Patent Office; Aircraft Production Board; all Army service schools; C. L. Norton, Massachusetts Institute of Technology, Cambridge, Mass.; Dr. Charles P. Steinmetz, General Electric Co., Schenectady, N. Y.; A. H. Beyer, chairman committee on testing laboratory, Columbia University, Broadway and 117th Street, New York City; R. R. Abbott, metallurgist, Peerless Motor Car Co., Cleveland, Ohio; Dr. John A. Matthews, president Halcomb Steel Co., Syracuse, N. Y.; Knox Taylor, president Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; Howard D. Colman, Baber-Colman Co., Rockford, Ill.; Preston S. Miller, Electrical Testing Laboratories, Eightieth Street and East End Avenue, New York City; Herbert Fisher Moore, University of Illinois, Urbana, Ill.; L. F. Miller, metallurgist, Mitchell Moore Co., 1832 Asylum Avenue, Racine, Wis.; E. J. Okey, the Timken Roller Bearing Co., Canton, Ohio; Dr. Aleš Hrdlička, curator division of physical anthropology, United States National Museum, Washington, D. C.

Any person desiring to submit an invention for consideration, test, sale or development should do so by letter, giving in order the following information: Name and object of the invention; any claim for superiority or novelty; any results obtained by actual experiment; whether the invention is patented; whether remuneration is expected; whether the invention has been before any other agency; whether the writer is owner or agent; the number of inclosures with the letter. A written description and sketches or drawings of sufficient detail to afford a full understanding of the cases should also be submitted. Should the invention be an explosive or other chemical combination, the ingredients and processes of mixture should be stated.

The Inventions Section will not bear the expense of preparation of drawings and descriptions, nor advance funds for personal or travelling expenses of inventors.

Any matter submitted will be treated as confidential. The inventor will be notified of each step taken during the investigation of his invention. All communications should be addressed: Inventions Section, General Staff, Army War College, Washington, D. C.

THE VOLUNTEER MEDICAL RESERVE CORPS

Dr. Franklin Martin, member of the advisory commission and chairman of the general medical board of the Council of National Defense, authorizes the statement that following out the plans for organizing the volunteer medical service corps, to enlist the services of physicians ineligible for camp or field duty, the medical section of the Council of National Defense is sending to several thousand doctors a letter which says in part:

> The Council of National Defense has authorized and directed the medical section of the council to

organize the physicians of the country who are ineligible for membership in the medical reserve corps on account of physical disability, over-age (55), civic or institutional needs, into the volunteer medical service corps. The members of this corps will be classified according to their ability to serve and will render aid to existing governmental agencies upon request of the Army, Navy, Public Health Service, American Red Cross, or the Council of National Defense.

It is hoped that every physician who, for any of the reasons enumerated above, is unable to enroll in the Medical Reserve Corps, will join the volunteer medical service corps. Since you have already indicated your desire to serve the government by applying for a commission in the Medical Reserve Corps you are among the first to be sent an application blank which it is hoped you will fill out and return immediately to this office.

The blank provides for details as to reason for ineligibility to the Medical Reserve Corps as to educational and professional experience and other details. The fact is also recognized that rejected applicants for service in the Medical Reserve Corps may overcome the physical defects that led to rejection, and may therefore become eligible, or that the essential public or institutional needs may become less important as the extreme needs of the Army and Navy become apparent. Each physician is asked, therefore, to pledge himself to apply for a commission in the Medical Reserve Corps if at any time he becomes eligible.

With the letter goes a leaflet setting forth the rules of the organization. The general management of the Volunteer Medical Service Corps is vested in a central governing board, which is a committee of the general medical board of the Council of National Defense, and the state governing boards consist of the state committees, medical section, Council of National Defense.

The procedure for joining is simple. The applicant returns his filled blank to the central governing board in Washington, and it is then referred to the proper state executive committee for its recommendations as to the qualifications of the applicant and as to the kind of work for which he seems most fitted.

The central governing board comprises the following: Dr. Edward P. Davis, president, Philadelphia; Dr. Henry H. Sherk, vice-president, Pasadena; Dr. John D. McLean, acting secretary, Washington; Dr. Edward H. Bradford, Boston; Dr. Truman W. Brophy, Chicago; Dr. Duncan Eve, Sr., Nashville; Dr. William Duffield Robinson, Philadelphia; Dr. George David Stewart, New York City; Dr. Franklin Martin, Chicago, and Dr. F. F. Simpson, Pittsburgh, are members *ex officio*.

THE NATIONAL RESEARCH COUNCIL

THE President has issued the following executive order:

The National Research Council was organized in 1916 at the request of the President by the National Academy of Sciences, under its congressional charter, as a measure of national preparedness. The work accomplished by the council in organizing research and in securing cooperation of military and civilian agencies in the solution of military problems demonstrates its capacity for larger service. The National Academy of Sciences is therefore requested to perpetuate the National Research Council, the duties of which shall be as follows:

1. In general, to stimulate research in the mathematical, physical and biological sciences, and in the application of these sciences to engineering, agriculture, medicine and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare.

2. To survey the larger possibilities of science, to formulate comprehensive projects of research, and to develop effective means of utilizing the scientific and technical resources of the country for dealing with these projects.

3. To promote cooperation in research, at home and abroad, in order to secure concentration of effort, minimize duplication, and stimulate progress; but in all cooperative undertakings to give encouragement to individual initiative as fundamentally important to the advancement of science.

4. To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the government.

5. To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the war, and to aid in the solution of these problems by organizing specific researches.

6. To gather and collate scientific and technical information, at home and abroad, in cooperation with governmental and other agencies, and to render such information available to duly accredited persons.

Effective prosecution of the council's work requires the cordial collaboration of the scientific and technical branches of the government, both military and civil. To this end representatives of the government, upon the nomination of the National Academy of Sciences, will be designated by the President as members of the council, as heretofore, and the heads of the departments immediately concerned will continue to cooperate in every way that may be required.

WOODROW WILSON

THE WHITE HOUSE,
11 May, 1918

SCIENTIFIC NOTES AND NEWS

DR. JOHN J. CARTY, colonel in the Signal Corps, until recently chief engineer of the American Telephone and Telegraph Company, was presented with the Edison medal for "meritorious achievement in the science and art of electrical engineering," on May 17, at the annual meeting of the American Institute of Electrical Engineers.

COLONEL HENRY S. GRAVES, forester of the United States Forest Service, has been elected an honorary member of the Royal Scottish Arboricultural Society of Edinburgh, Scotland, in recognition of his eminent services to forestry. This distinction is shared by Colonel Graves with only one other citizen of this country, Dr. C. S. Sargent, who was elected in 1889.

AT the annual meeting of the American Academy of Arts and Sciences held on May 8, acting on the recommendation of the Rumford Committee, it was unanimously voted to award the Rumford Premium to Theodore Lyman for his researches on light of very short wavelength.

AT the commencement exercises of Colgate University, on May 7, the honorary degree of doctor of science was conferred upon Dr. Charles H. Herty, editor of *The Journal of Industrial and Engineering Chemistry*.

DR. ALEXIS CARREL, of the Rockefeller Institute, has been promoted by the French government to the rank of Commander of the Legion of Honor. The new decoration was bestowed on May 16 by M. Mourier, Under Secretary of State for Medical Service, in the presence of a distinguished company. M. Mourier recalled Dr. Carrel's biological discoveries, his method of transfusion of blood, his conservation of living tissue, and his method of grafting bones, as well as the system of treating wounds which he has developed at the hospital at Compiègne.

THE Franklin Institute, on May 15, 1918, made the annual presentation of its Franklin Medal in the auditorium of the Institute. The Franklin Medal, founded in 1914 and awarded only to "those workers in physical science or technology, without regard to country, whose efforts, in the opinion of the Institute, have done most to advance a knowledge of physical science or its applications," was awarded to Signor Guglielmo Marconi, electrical engineer and member of the Italian Senate, and to Dr. Thomas Corwin Mendenhall, physicist, of Ravenna, Ohio. The award to Senator Marconi was made in recognition of his "brilliant inception and successful development of the application of magneto-electric waves to the transmission of signals and telegrams, without the use of metallic conductors." The award to Dr. Mendenhall was made in recognition of his "fruitful and indefatigable labors in physical research, particularly his contributions to our knowledge of physical constants and electrical standards." His Excellency, Count V. Macchi De Cellere, on behalf of the Royal Italian Government, received the Franklin Medal for Senator Marconi, and addressed the institute when the medal was presented to him. Upon the presentation of the Medal to Dr. Mendenhall, he addressed the institute on the subject of "Some Metrological Memories."

MAJOR O. M. LELAND, of the 303d Regiment of Engineers, stationed at Camp Dix, has been appointed Lieutenant Colonel of Engineers in the National Army and assigned to the above regiment. Colonel Leland is professor of astronomy and geodesy at Cornell University,

on leave of absence for the duration of the war.

THE Massachusetts Institute of Technology has granted leave of absence to Professor Dugald C. Jackson, head of the department of electrical engineering, who has gone into government service, with the commission of major, and to F. H. Lahee, assistant professor of geology. Three men have resigned their positions, Ernest W. Chapin, research assistant in electrical engineering, who has been drafted, and Paul H. Burkhardt and Guy A. Gray, assistants in electrical engineering, who have gone to the Bureau of Standards in Washington. Professor D. F. Comstock, of the department of physics, has resigned.

FROM the department of chemistry of the College of the City of New York, Assistant Professor F. E. Breithut, who has already been granted a leave of absence for the duration of the war, has been commissioned as captain in the U. S. Army, and has reported for duty; Dr. B. G. Feinberg, tutor in chemistry, has been appointed research chemist in the Ordnance Division of the United States Army and was ordered to report for duty May 17; Mr. D. L. Williams, instructor in chemistry, has been called into the national service to be in charge of the Division of Supplies of the Research Department of the Gas Warfare Section of the United States Army, to report by June 1 at the latest. Mr. Paul Gross, tutor in chemistry, has been commissioned as second lieutenant in the United States Army, and was required to report for duty in Washington on May 9.

IT is reported from Oberlin College that Professor F. O. Grover, of the department of botany; Professor C. W. Savage, of the department of hygiene and physical education, and Professor S. R. Williams, of the department of physics and astronomy, will be away next year on sabbatical leave.

DR. McIVERY WOODY, secretary of the medical faculty of Harvard University, and Dr. W. G. Webber, of the department of preventive medicine and hygiene, have been commissioned in the Medical Reserve Corps.

WILBUR A. NELSON has been elected state geologist of Tennessee.

MISS EDITH TALPEY, of Bayside, has been appointed chief chemist at the big plant of the General Chemical Company, at Kingston, Ontario. For the past four years she has been working in the laboratory of the Company at Long Island City.

HERBERT P. WHITLOCK has been appointed curator of mineralogy in the American Museum of Natural History in succession to the late Louis P. Gratacap. A correspondent writes: "Mr. Whitlock leaves his position as mineralogist in the New York State Museum at Albany after serving for a period of fourteen years. During this time he has brought the state collection of minerals to a high degree of excellence and has helped to make it a complete representation of the mineral occurrences of New York. Mr. Whitlock is well known for his published papers, principally on crystallographic mineralogy."

DR. M. R. GILMORE, curator of the North Dakota State Historical Society, delivered a series of lectures before the faculty and students of the University on May 2, 3 and 4, on "Native culture and its geographic relations." The subjects presented in the series were: "The relation of human culture to geographic influences," "Native culture of the Great Plains Region," and "The history of Indian corn."

THE death is announced of A. Montuori, instructor in physiology at the University of Rome and director of the Institute for Physical Education and Experimental Physiology.

THE forestry department of the University of California, and its head, Professor Walter Mulford, believes that the intimate relation between the forest and wild life demands that the well-trained forestry student know something of fish and game and methods by which this resource may be conserved. It therefore procured the services of Dr. Harold C. Bryant, in charge of the educational, publicity and research work of the California Fish and Game Commission, to give instruction on game fish, birds and mammals, their economic

value, and the means by which they may be conserved. The following were the subjects announced, each lecture illustrated with stereopticon slides.

April 5. "Geographical distribution of plant and animal life in California."

April 8. "Some common game and non-game birds of California."

April 10. "The economic value of birds."

April 12. "The game and furbearing mammals of California."

April 15. "Mammals in their economic relations."

April 27. "Food and game fishes and their conservation."

April 19. "Past, present and future of game in California."

April 22. "The national forests and wild life."

April 24. "Methods of wild life conservation."

Through the Urgent Deficiency Bill passed by Congress and approved by the President, March 28, 1918, the Bureau of Fisheries was provided with the sum of $80,000 for the construction and equipment of a fireproof laboratory building at Fairport, Iowa, to replace the frame building destroyed by fire on December 20, last. This prompt action of the Congress at the present time is a source of much gratification as an evidence of appreciation of the importance of the biological and fish-cultural experiment and other work accomplished and in progress at the station. Plans are being prepared in order that construction may be begun as soon as possible. Meantime, arrangements have been made whereby a limited number of temporary investigators can be furnished with working quarters and living accommodations during the coming season. The important work of the laboratory will therefore proceed with the least possible interruption.

The National Forest Reservation Commission has authorized the purchase by the government of 65,528 acres of land in the White Mountain and Southern Appalachians for inclusion in the Eastern National Forests. Four tracts, with a total of approximately 38,000 acres on the Nantahala Purchase Area in Macon and Clay counties, N. C., comprise the largest amount authorized in any one locality. The acquisition of these lands will give the government control of the majority of the mountain lands on the headwaters of the Nantaha River and will fill in the southern end of the area which it is planned to buy in that locality. Most of the land has either been cut over or is to be purchased subject to the removal of the timber under government regulations. Other lands whose acquisition was approved comprise 993 acres in Grafton county, N. H., and Oxford county, Me.; 14,676 acres in Highlands, Augusta, Amhearst and Botetourt counties, Va.; 2,788 acres in Avery, Buncombe, Yancey, and Macon counties, N. C.; 4,341 acres in Polk, Monroe and Unicoi counties, Tenn.; 2,898 acres in Winston and Lawrence counties, Ala., and 1,834 acres in Hardy county, W. Va.

The New York Civil Service Commission announces that it will receive applications for the position of mineralogist in the State Museum at a salary of $1,600 ($1,740 beginning July 1, 1918) for men only. Applicants should be graduates of a university, college or technical school and specially trained in the science of mineralogy. They should also have a general knowledge of descriptive mineralogy with special knowledge of minerals occurring in the state of New York, together with knowledge of the economic uses of minerals and their application to modern industries.

Dean Thatcher and Professor Alway, of the division of soils of the University of Minnesota, have recently completed negotiations for securing a peat experimental farm near Goodrich, Minn. The law requires that there be maintained three such farms. They have been located at Dibbell, Goodrich and Anoka.

The government of Uruguay is discussing the foundation of an Academy of Sciences, Arts and Letters. It is proposed that it shall be composed of five institutes, one each for the medical sciences, the political sciences, the natural sciences, arts and belles lettres.

Free public lectures have been inaugurated at the Brooklyn Botanic Garden by a course of "Win-the-War-Garden" lectures, scheduled for Sunday afternoons at 4 o'clock. The lectures illustrated by lantern slides and otherwise are given in the lecture hall of the new

laboratory building. A motion-picture apparatus is being installed in the lecture hall to be used especially in connection with lectures to children. The following lectures were announced:

April 7. "Farming for women." Miss Sophia de M. Carey, official lecturer of the British government; Miss Elizabeth Cleveland and Mrs. Florence Young, Bedford farmerettes and members of the Woman's Land Army of America.

April 14. "The back yard vegetable garden." Miss Jean A. Cross, assistant curator of elementary instruction.

April 21. "Forest products and the war" (Arbor Day Lecture). Professor Samuel J. Record, school of forestry, Yale University.

April 28. "Diseases of garden crops and how to control them." Dr. Edgar W. Olive, curator of Public Instruction.

May 5. "Plant breeding and increased food production." Dr. Orland E. White, curator of Plant Breeding.

May 12. "Bacteriology and the war." Dr. Ira S. Wile, former member of the Board of Education, New York City.

May 19. "Garden insects—good and bad." Dr. E. P. Felt, State Entomologist of New York.

May 26. "Cultivation of drug plants." Dr. W. W. Stockberger, in charge of drug and poisonous plant investigations, U. S. Department of Agriculture.

THE Sigma Xi Society of Syracuse University has arranged a number of public lectures to inform the students and general public of interesting and timely scientific problems. In addition to those already reported the following have been held:

January 11. "The service of botany to the nation during and after the war." Dean Wm. L. Bray, of the Graduate School of Syracuse University.

April 5. "Mt. Katmai and the valley of ten thousand smokes." Professor Robert F. Griggs, of Ohio State University, director of the National Geographic Society's expeditions to Mt. Katmai.

April 19. "The habits of spiders." Professor J. H. Comstock, emeritus professor of entomology of Cornell University.

THE summer meeting of the American Institute of Chemical Engineers will be held in Berlin, N. H., June 19–22. Headquarters will be at Mt. Madison House, Gorham, N. H.

THE National Medical Institute of Mexico, founded in 1890 for research on and exploitation of the flora, fauna and climatology and geography of Mexico has been transformed into the Institute of General and Medical Biology by a recent decree. The institute has been engaged in the study and classification as well as the action of native plants.

THE Royal Academy of Sciences of Turin, Italy, has announced a prize of 26,000 lire, to be awarded for the most remarkable and most celebrated work on any of the physical sciences published in the four years ending December 31. The prize fund is a bequest from a senator of the realm, T. Vallauri. Competition is open to Italian and foreign scientific men, and the term "physical sciences" is to be taken in the broadest sense.

THE Provost Marshal General made public the following: "Under such regulations as the Chief Signal Officer may prescribe, a proportion of the students in institutions in which the Signal Corps has established a course in electrical communication, who have completed at least two and a half years of the course in electrical engineering, or its equivalent, in one of the approved technical engineering schools listed in the War Department, may enlist in the Signal Enlisted Reserve Corps, and thereafter, upon presentation by the registrant to his local board of a certificate of such enlistment, such certificate shall be filed with the questionnaire and the registrant shall be placed in Class 5 on the ground that he is in the military service of the United States."

UNIVERSITY AND EDUCATIONAL NEWS

UNDER bequests of the late William Brechin Faulds, of Glasgow, a research fellowship in medicine, of the annual value of about £200, tenable for three years, has been founded in the university. The Ferguson trustees have announced their intention of founding a research fellowship in applied chemistry, also of the annual value of £200.

THE new agricultural building of the Maryland State College of Agriculture, costing

$175,000, will be dedicated during "Farmers' Day" at the college on May 30.

The contract has been let for the construction of a new fireproof chemistry building at the Montana State College, Bozeman. This building replaces the one destroyed by fire in October, 1916. The building will cost $110,000, exclusive of furniture and is 130 × 60. This forms a unit of a larger building plan to be developed as the institution grows. The building will furnish quarters for the experiment station and college departments of chemistry as well as quarters for the state food and water laboratories.

Dr. A. E. Kennelly, professor of electrical engineering at the Massachusetts Institute of Technology, has been appointed acting head of the electrical engineering department of the institute during the absence of Professor Jackson, who has been commissioned a major.

At the Harvard Medical School three members of the medical faculty have been promoted to full professorships as follows: Dr. Richard C. Cabot, clinical professor of medicine; Dr. Eugene A. Crockett, Le Compt professor of otology, and Dr. F. S. Newell, clinical professor of obstetrics.

Lester F. Weeks, assistant professor of chemistry in the University of Maine, has been appointed assistant professor of chemistry at Colby College to succeed Dr. Robert G. Caswell, who has resigned.

At Wellesley College, Lincoln W. Riddle, associate professor of botany, William Skarstrom, associate professor of hygiene, and Roxana Hayward Vivian, associate professor of mathematics, have been appointed to full professorships.

DISCUSSION AND CORRESPONDENCE

WALNUT POLLEN AS A CAUSE OF HAY FEVER

The prevalent assumption that the tree pollens play only a minor rôle, if any, as causative factors in hay fever must now be abandoned, since one species alone has been demonstrated to be the cause of hundreds if not indeed thousands of cases in California.

The spring type of this malady is very troublesome in the Sacramento valley, where it has been commonly attributed, even by physicians, to locust and to orange pollen. However, predictions based upon botanical characters that these pollens would give negative results were thoroughly substantiated by intradermal tests in which the pollen extracts were used. At the request of Dr. Grant Selfridge, of San Francisco, the writer therefore visited the city of Colusa in April, 1917, to determine, if possible, the specific cause or causes of the trouble. It was noted that the native California black walnut (*Juglans californica* var. *Hindsii* Jepson) was much used as a street tree, that the abundant pollen sifted down over the city just at the time when the disease was most prevalent, and that the disease disappeared soon after the close of the flowering period. It was also learned that when patients left the region temporarily to escape the disease they were free from the symptoms, except when passing through towns where the black walnut grew. Finally, the botanical characters of the pollen were exactly those which one would expect in a hay-fever plant. Since this evidence all pointed to the walnut as probably the chief offender, samples of the pollen were gathered and biological tests were made by Dr. Selfridge on some eight subjects. In each case the results were positive.

Twelve hay-fever subjects were also examined at Chico, a neighboring city, where cases are abundant during the spring and where the walnut is much grown as an ornamental tree. In every case positive reactions were obtained with extracts prepared from the California black walnut pollen, whereas the controls gave no reactions. Other pollen extracts gave results in a few cases, indicating that the subjects were sensitive to these also. This was especially true of western mugwort (*Artemisia heterophylla*) which is a common cause of the fall type. The intradermal tests were verified by direct application to the nostrils, and the well-known symptoms of hay fever were immediately produced in each case.

The treatment of numerous hay-fever subjects in the Sacramento and neighboring val-

leys to render them immune to hay fever is now under way and the serums prepared from the black walnut pollen are the ones most used. It is expected that by this means the spring type of the malady can be largely eliminated in those districts. A more direct method would be to remove the trees, or, better yet, to graft the tops over to English walnut, which rarely, if ever, causes hay fever. By this latter method the beautiful and stately trees along the highways and in the parks could be preserved, but it would doubtless be difficult to bring about unanimity of action.

The relation of the eastern black walnut to hay fever should now be determined since that species is closely related botanically to our western form. It may also be pointed out that perhaps the most significant result of our studies, which cover the region from the Rocky Mountains west, is the discovery that hay fever is here produced by an almost entirely different flora from that which causes it in the eastern states and in Europe, and that the exact species involved must be determined in each case before treatment for immunity is undertaken. Botanical surveys and clinical tests have been carried on by Dr. Selfridge and the writer in order to determine the most important species for each district and these will be continued as opportunity offers.

HARVEY MONROE HALL
DEPARTMENT OF BOTANY,
UNIVERSITY OF CALIFORNIA

THE CANONS OF COMPARATIVE ANATOMY

IN a recent number of this journal[1] Professor E. C. Jeffrey uses "an article on the vessels of *Gnetum* in the January number of the *Botanical Gazette*" as a "flattering testimonial" to the soundness of what he has called the canons of comparative anatomy and at the same time (to modify his pun) as an illustration of poor marksmanship in the use of those canons. As the author of that article and as a firm supporter of those canons, I am glad to offer my work as a testimonial to their soundness and to their effectiveness in anatomical offensives. But, according to Professor Jeffrey, my marksmanship was defective because I stated—and in so doing showed "surprising ignorance"— that the vessels of *Gnetum* are different from those of angiosperms. Aside from the fact that this statement does not involve the use of the canons at all, the whole theme of the article was that the *same* type of vessel has been evolved in *Gnetales* and angiosperms in entirely different ways. On page 90 for example I wrote:

> The possession of vessels by the two groups . . . is to be used as a remarkable illustration of development by different plants of the *same* highly specialized structure.

Again on page 89 after speaking of the perforation of the Gnetalean vessel I said:

> We have also seen that the similar single large perforation of the angiosperm vessel, etc.

Professor Jeffrey seems to have misunderstood what was in my mind because of my statement that the vessel of *Gnetum* is like the *highest* angiosperm type except that as a rule it exhibits a narrow border. Yet every anatomist will agree that this statement is absolutely correct because the *highest* type of angiospermic vessel *has no* border on its perforations. Of course every anatomist knows that the perforations of many angiospermic vessels do show a border as do those of *Gnetum*, but these are not of the highest type.

It appears, therefore that our modern scientific promulgator of canons is in certain respects remarkably like his ecclesiastical predecessors.

W. P. THOMPSON

[1] SCIENCE, N. S., Vol. XLVII, No. 1214.

ALBINO TURKEY BUZZARDS

IN a recent issue of SCIENCE[1] there appeared an interesting note on the supposed occurrence of albino turkey buzzards (*Cathartes aura aura*) in Mexico, to which Mr. E. W. Nelson has called the writer's attention. This was based on the account of white "Carrion Crows" given by Captain William Dampier in his "First Voyage to the Bay of Campeachy." That Dampier mentions these white birds as of more or less common occurrence in that locality at once raises a doubt of their identification as turkey buzzards; and this

[1] Gudger, SCIENCE, N. S., Vol. XLVII., No. 1213, March 29, 1918, pp. 315–316.

doubt is strengthened almost to a certainty by recollection of the fact that the king vulture, which is well known in that region, is of about the same size and general habits as the turkey buzzard, and in plumage almost wholly white or whitish; as Dampier expresses it, "their Feathers looked as if they were sullied." Furthermore, he states that the inhabitants of Campeche called them "King-Carrion Crows." It is evident, therfore, that we must identify Dampier's white "Carrion Crows" as king vultures (*Gypagus papa*).

It might be well, moreover, in this connection, to mention that albinos of the turkey buzzard, or, as it is more properly called, the turkey vulture (*Cathartes aura*), are by no means extraordinary, though of course not common. The present writer has, during the course of several years, examined a number of specimens; and among recorded instances we might mention that of Nauman in Florida[2] and Gundlach in Cuba.[3]

HARRY C. OBERHOLSER

BIOLOGICAL SURVEY,
WASHINGTON, D. C.

[2] *American Naturalist*, IV., August, 1876, p. 376.
[3] *Auk*, VIII., April, 1891, p. 190.

SCIENTIFIC BOOKS

The Early Mesozoic Floras of New Zealand: By E. A. ARBER. New Zealand Geological Survey, Paleontological Bulletin No. 6. 1917.

Fossil plants have been known from New Zealand for over half a century, but there has never been a comprehensive account of them published, and the wide variations in the opinions of the local geologists and paleontologists regarding the ages of the important stratigraphic units has made it impossible for students elsewhere to reach any intelligent understanding of the situation. Such an understanding is especially important in the case of so interesting and strategic a region, and its former relations to Gondwana Land, Antarctica and Australia have long been controverted questions.

The present comprehensive account of the older Mesozoic floras is therefore of great value to paleogeographers and to students of geographical distribution. The more important localities from which the fossil plants are described are the Rhætic of Mount Potts and Clent Hills in Canterbury and the Hokonui Hills in Southland; Owaka Creek in Otago is doubtfully referred to the Rhætic; Mokoia and Metaura Falls in Southland are referred to the lower Jurassic; Malvern Hills in Canterbury is doubtfully referred to the lower Jurassic; Waikawa in Southland to the middle Jurassic; and Waikato Heads in Auckland to the Neocomian.

The disputed question of the occurrence of *Glossopteris* is definitely answered in the negative and it is shown that there was considerable specific variation between the Rhætic flora of New Zealand and that of Australia, India and South Africa. The Jurassic floras appear to show less specific differences when compared with other areas. The author concludes that New Zealand was surely united with Australia during Rhætic and Jurassic times, but he objects strongly to using the term Gondwana Land for anything post-Paleozoic, although it is obvious that the existence of Gondwana Land as a geographical region did not cease with the close of the Paleozoic. Many geologists have also reached the conclusion that the evidence for the lower Permian age of the glacial period is sufficiently good to warrant the dropping of the term Permo-Carboniferous for it, although doubtless this practise will survive indefinitely in more conservative countries like Great Britain.

It would seem to the reviewer that it would have been preferable to use Mesozoic instead of Mesophytic for the floras discussed, since the latter term has a well-understood ecological significance. The perpetuation of the use of *Sphenopteris* for post-Paleozoic fern fragments is also to be deprecated, and it is questionable if clearness of understanding is facilitated by substituting *Tæniopteris* for *Oleandra* and *Macrotæniopteris*. Of great interest is the discovery of two forms of dicotyledonous leaves in beds referred to the Neocomian. These are described by Professor

Laurent, of Marseilles, who refers one to Unger's genus *Artocarpidium* and does not venture beyond *Phyllites* in the identification of the other.

While not absolutely unique, even if the age is as great as is assigned to them, since some of the leaves described by Fontaine from the Neocomian of Virginia may be dicotyledonous, the New Zealand examples are less ambiguous. It may be pointed out however that Lower Cretaceous and Neocomian are not synonymous terms, as one might infer the author to believe, and no evidence is presented which would indicate that these New Zealand deposits could not be Barremian, Aptian or even Albian in age, and in the last stage dicotyledons are fairly common in both America and Europe.

A table giving the distribution of the New Zealand species in other regions would have added much to the usefulness of the report.

E. W. Berry

The Johns Hopkins University,
Baltimore

SPECIAL ARTICLES

THE FACTORS INFLUENCING THE ATTITUDE OF THE HEAD IN ANIMALS WITH INJURY TO ONE OTIC LABYRINTH

Magendie, more than a century ago, recognized that the central nervous system participated in the maintenance of the attitudes of the body as well as in its movements. Recently Sherrington has called attention to this function under the head of the postural activity of muscle nerve. The attitude of the head is one of the characteristics of experimental removal of one otic labyrinth in animals, and the analysis of the factors involved becomes of importance from the point of view of the relation of the attitude of the head to the maintenance of the position of the body in space and hence, to the problem of the maintenance of equilibrium, as well as from its own intrinsic interest. This analysis was begun by Dr. A. L. Prince, of Yale,[1] in this laboratory more than two years ago, but his service in a base hospital of the American Forces in France led to an interruption of the experiments. We desire to add a brief statement of new experiments at this time. We hope later to publish the data in full with Dr. Prince as the senior author.

The torsion of the head, always seen after removal of one otic labyrinth, with the occiput turned toward the injured side, largely disappears after removal of the homolateral cerebral motor cortex in dogs. The torsion reappears if the heterolateral cerebral motor area is removed some weeks or months after the ablation of the homolateral area.

The torsion of the head is greatly increased, and the rolling movement toward the side of the injured labyrinth, together with the ocular movements (ocular nystagmus) reappear, if the heterolateral cerebral motor cortex is removed some weeks after the time of the labyrinthine operation. Rolling movements of the animal to the side of the remaining cerebral motor area reappear, but no nystagmus, if one cerebral motor area is removed some weeks after bilateral labyrinthine operation.[2]

Our experiments have given a new interest to Magendie's statement that the division of the central nervous system into segments, *e. g.*, medulla oblongata, cerebellum and cerebrum, is an artificial division from the point of view of the physiologist, and that all parts must be considered together in arriving at an estimate of its functions.

B. Aronovitch,
F. H. Pike

The Department of Physiology,
Columbia University

[1] *Proceedings of the Society for Experimental Biology and Medicine*, 1916, XIII., p. 156.

[2] Unpublished experiments by Drs. Strauss and Friesner.

A SLOW-SPEED KYMOGRAPH

Physiologists and others using the "medium-spring" kymographs of the Harvard Apparatus Company, which are not provided with a slow-speed mechanism, may be interested in a simple device I have used for materially reducing the speed of the drum. It is shown in the appended figure. A small hole is drilled in the upper corner of the largest fan, and into it is tied a strong but flexible

thread. To the other end of the thread is attached a lead ball a quarter inch in diameter. The length of thread and ball together is equal to the width of the fan. An L-shaped brass wire, with the short arm ending in a loop, is fastened to the top of the kymograph by the screw nearest the fan. The fan clears the vertical arm of the wire by a quarter inch. As the fan revolves, the lead weight swings outward and winds itself momentarily about the upright wire, bringing the fan to a brief halt at each revolution. The speed of the

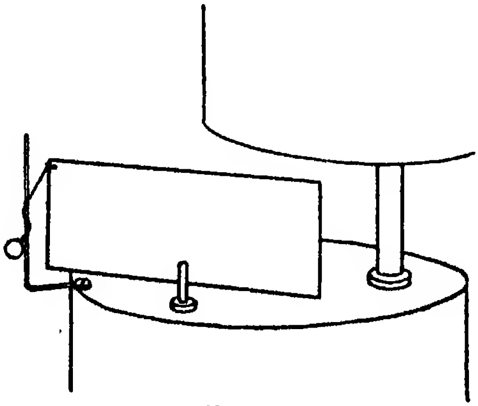


Fig. 1.

drum is thus reduced from one revolution in half an hour to one revolution in three hours and a half. Once properly adjusted the device works unfailingly. Eugene L. Porter

Department of Physiology,
The University of Pennsylvania

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and ninety-eighth regular meeting of the society was held at Columbia University on Saturday, April 27, extending through the usual morning and afternoon sessions. Thirty-three members were in attendance. Professor H. S. White presided at the morning session and Professor W. B. Fite at the afternoon session. The following new members were elected: Mr. Oscar S. Adams, U. S. Coast Survey; Professor William P. Parker, Union Christian College, Pyeng Yang, Corea; Dr. Eugene F. Simonds, University of Illinois. Seven applications for membership were received. Professor P. F. Smith was reelected a member of the Editorial Committee of the *Transactions*. A committee was appointed to consider the question of the publication of the recent Chicago symposium.

The following papers were read at this meeting:

Arnold Emch: "On plane algebraic curves with a given system of foci."

J. F. Ritt: "On the iteration of polynomials."

F. F. Decker: "On the order of the system of equations arising from the vanishing of determinants of a given matrix."

O. E. Glenn: "Modular concomitant scales, with a fundamental system of formal covariants, modulo 3, of the binary quadratic."

J. E. Rowe: "The quinquesecant line invariant of the rational sextic curve in space."

F. H. Safford: "Parametric equations of the path of a projectile when the air resistance varies as the *n*th power of the velocity."

C. L. E. Moore: "Surfaces of rotation in space of four dimensions."

C. L. E. Moore: "Translation surfaces in hyperspace."

Mary F. Curtis: "Note on the rectifiability of a space cubic."

F. R. Sharpe and Virgil Snyder: "Certain types of involutorial space transformations."

Caroline E. Seely: "On kernels of positive type."

J. W. Hopkins: "Some convergent developments associated with irregular boundary conditions."

J. R. Kline: "A necessary and sufficient condition that a closed connected point set that divides the plane into two domains be a simple curve."

Edward Kasner: "Equilong symmetries and a related group."

H. B. Phillips: "Functions of matrices."

G. H. Hallett, Jr.: "Linear order in three-dimensional euclidean and double elliptic spaces."

H. S. Vandiver: "On transformations of the Kummer criteria in connection with Fermat's last theorem."

H. S. Vandiver: "A property of cyclotomic integers and its relation to Fermat's last theorem."

H. S. Vandiver: "Proof of a property of the norm of a cyclotomic integer."

The San Francisco Section met at Stanford University on April 6 and the Chicago Section at the University of Chicago on April 12–13. The next meeting of the society will be the summer meeting, at Dartmouth College, early in September.

F. N. Cole,
Secretary

SCIENCE

Friday, May 31, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE VALUE AND SERVICE OF ZOOLOGICAL SCIENCE[1]

ESTHETICAL AND RECREATIONAL VALUES

We are met together in a world convulsed by strife, resounding with the measured tramp of armies, with the clash of arms, and into the vortex of this world-wide conflict our own nation has been drawn. Back of the rising smoke of battle towers the gaunt figure of materialism. It is greed of material gain, it is lust of dominion, wherewith to reap this gain, that has precipitated this mighty struggle.

All nations have allowed themselves to fall in more or less degree under the sway of this materialism, and we ourselves are not without guilt in this respect, though not so guilty as our critics would fain have us believe. It was not to be wondered at that under these conditions many at first saw in this war only the rivalry of sordid interests, that they hesitated to take sides in a struggle in which they conceived the end not as the triumph of noble principles but as the supremacy of commercial advantage, that our critics charged us with seeking to serve only our own selfish interests and taxed us with hypocrisy when on entering the conflict we renounced material gain and raised the banner of truth and justice.

But exposed to the heat of this conflagration and in the crucible of suffering men's ambitions have been refined, the metal has been freed from the dross. As the struggle has progressed, another figure—the figure of idealism—has become defined, ris-

[1] Symposium before the American Society of Zoologists, Minneapolis, December 29, 1917.

ing youthful, strong and virile, and the meaning of the conflict stands plainly revealed. It is the age-long struggle between the multitude and the privileged few, between the rights of the people and the divine right of kings, between the conception of government which makes the state the servant of the people who have created it and that which reduces them to slaves and places not only their possessions but their lives, at the disposal of the divinely appointed rulers of the state, and even demands that their consciences be subservient to the will of the sovereign. Gradually as the issue has defined itself more and more clearly, the logic of events has forced nations whose entrance into the struggle may have been in a degree dictated by other and less noble motives to commit themselves definitely and unmistakably with respect to these fundamental principles and the sympathy of the individual must be bestowed for or against the democracy in which we who are truly Americans all believe.

But so confused and so clouded have been the issues, so bitter the struggle, waged both with the pen and the sword, that some have doubted the value of art, of literature, of science, of religion, and even of civilization itself. Ingenious logic has lent itself to so interpret and apply the principles of our *own* science as to justify the theory that might makes right, that the weak have no rights which the powerful can be bound to respect, that the strong nation is justified in taking possession of and administering the heritage of its weaker neighbors even though it be necessary to exterminate the weaker in so doing.

The conflict has been severe. The forces of might, better prepared, better organized, more effectively administered, and profiting also by advantages of strategic position, have seemed to be on the high road to success. The issue still hangs in the balance, and victory for the right is not yet assured. Therefore, there are those who, faint-hearted, have despaired and, blinded by the apparent success of might, have lost faith in right and have recanted, laying the blame upon the idealists for having led them astray. They now profess admiration for the strength of materialism and decry the weakness of an idealism which breeds a race of cowards and weaklings. But are they justified? While it is true that idealism, uncontrolled by reason, may build a house of cards which in time of stress collapses and buries both its followers and those associated with them, can this be affirmed of that idealism through which shines the clear light of reason? Though the believer in truth, justice and right hesitates to draw the sword, is he not the stronger, relatively, if when he does so, he enters the conflict with clear conscience and high resolve? One looks in vain through the history of the ages for a case where freemen have been lacking in the courage to uphold their convictions, even in the face of the most oppressive opposition, or to defend them, if necessary, by force of arms.

It is this spirit of idealism which led our nation at first to give generously and individuals to sacrifice much that the sufferings of war might be mitigated, and which, though we were long forbearing, led us, when reason had shown clearly the necessity of so doing, to enter the conflict, actuated by motives more altruistic than those which have impelled any nation in the previous history of this world. It is idealism that is leading our young men willingly into a crusade which takes them far across the sea, to endure privations, suffering and death itself, while their loved ones, who have bid them "God-speed" with tears in their eyes but with the pride of sacrifice in their hearts, pray for their success, and

hope for their return. Materialism is strong, but idealism, stronger still, is the most powerful force in the world to-day. We can not doubt the outcome of the struggle, with our tremendous resources added to those of the nations with whom we are associated, and with the consciousness of high moral purpose to animate our armies.

Not only is idealism a force to be reckoned with now but from it we draw our faith in the future. When the nations come around the conference table to adjust terms of peace, the promise of the future will rest in the degree to which idealism is able to sway the council. Should materialism, perchance, assert itself, only a truce is possible. The evolution of justice as between man and man can be slowed and even stayed for a time, but can not be long arrested.

If then so much depends upon this force, if in it rests our faith in the present and our hope in the future, we should do well to investigate fully its nature and to determine as precisely as possible the factors that contribute to its development. Such a pursuit, however, does not lie within the limits of this discussion; it is appropriate only to raise the question whether a love for the beautiful and the cultivation of it—that is, esthetics and esthetic training—are not among such factors.

Idealism in last analysis rests upon a keen perception of truth, right and justice, and this involves that which is esthetic as well as that which is ethical. A recent writer on esthetics[2] says that

> esthetic and moral judgments are to be classed together in contrast to judgments intellectual. . . . Esthetic judgments are mainly positive, that is, perceptions of good, moral judgments are mainly and fundamentally negative, or perceptions of evil. . . . Esthetics deals with values which are immediate, moral values are always remote. . . . Not only are the various satisfactions which morals are meant to secure esthetic in the last analysis, but when the conscience is formed and right principles acquire an immediate authority, our attitude to these principles becomes esthetic also. Honor, truthfulness and cleanliness are obvious examples.

Esthetic perception should not be confused with artistic production, although esthetic desire is back of and tinges all art. Thus interpreted art is subjective, esthetics objective. The study of animal life has been a source of inspiration to artists of all time and apparently the earliest beginnings of decorative art consisted in the crude drawings of men and animals traced by cave men on the walls of the caverns which sheltered them. Many conventional designs when traced back through the successive steps which mark their evolution lead to representation of animals which because of some peculiarity of form excited the imaginations of aboriginal man. But we are not concerned directly with the value of animal study or the services of such study to art, great as they have been. It is the appeal which the study of animal forms makes to our sense of the beautiful that interests us here.

In order to appreciate beauty, estheticians tell us, we must put ourselves in the place of that which excites the sensation, in a certain sense project ourselves into it. And as we do so "our motor activities rehearse the tensions, pressures, thrusts, resistances, efforts, the volition, in fact the life, with its accompanying emotions, which we project into the form and attribute to it."[3] Thus the sensation of beauty is a motor as well as a sensory phenomenon. If this sensation is one of pleasure we ascribe to the object the possession of beauty, if the opposite, of ugliness. But all sensations of

[2] Santayana, "The Sense of Beauty" (1910), pp. 23 *et seq.*

[3] Lee and Anstruther-Thompson, "Beauty and Ugliness" (1912), p. 28.

pleasure are not accompanied by the perception of beauty. Pleasant as our recollections of a certain dinner may be we would hardly refer to it as beautiful, even to compliment the most gracious hostess. The frequent repetition of esthetic experience gradually develops in the individual a greater susceptibility to such stimulation, in which regard esthetic pleasure differs from other pleasures the frequent indulgence in which leads to satiety and even repulsion.

This ability to project ourselves, which with respect to other creatures, leads to that we call sympathy, is a most valuable acquirement. It needs no argument to prove that it tends to develop unselfishness, humanitarianism, and ultimately a love of truth, right and justice, which is idealism. The cultivation of esthetics, therefore, is clearly not only *one* factor in the production of idealism, but perhaps the most important factor of all.

If one compare his impression with regard to a beautiful object with that of others he soon learns that the impression of each person is different, depending on previous experience, training and point of view, and that perceptions of beauty are always individualistic. The perceptions of two individuals may approximate one another if the basis of the one approximate that of the other, but as each has his own personality so each has his own perceptions of beauty. If one be honest with himself and others this tends to develop a respect for others' opinions and his sense of fellowship with the rest of mankind.

To quote again from a text referred to above:[4]

It would be an error to suppose that esthetic principles apply only to our judgments of works of art or of those natural objects which we attend to chiefly on account of their beauty. . . . In the leading political and moral idea of our time, in the idea of democracy, I think there is a strong esthetic ingredient, and the power of the idea of democracy over the imagination is an illustration of the effect of multiplicity in uniformity. . . . Of course, nothing could be more absurd than to suggest that the French Revolution . . . had an esthetic preference for its basis; it sprang, as we know, from the hatred of oppression, the rivalry of classes, and the aspiration after a freer social and strictly moral organization. But when these moral forces were suggesting and partly realizing the democratic idea, this idea was necessarily vividly present to men's thoughts; the picture of human life which it presented was becoming familiar, and was being made the sanction and goal of constant endeavor. . . . The consequence was that democracy, prized at first as a means to happiness and as an instrument of good government, was acquiring an intrinsic value; it was beginning to seem good in itself, in fact the only intrinsically right and perfect arrangement. A utilitarian scheme was receiving an esthetic consecration. The practical value of the arrangement on which, of course, it is entirely dependent for its origin and authority, was forgotten, and men were ready to sacrifice their welfare to their sense of propriety; that is they allowed an esthetic good to outweigh a practical one.

It was becoming an ideal.

Esthetic love of uniformity, however, is usually disguised under some moral label; we call it the love of justice, perhaps because we have not considered that the value of justice also, in so far as it is not derivative and utilitarian, must be intrinsic, or what is practically the same thing, esthetic.

The same author emphasizes the idea that beauty is a species of value and the philosophy of beauty a theory of values. If this be true then another value of esthetic training is that it educates the judgment. One is inevitably led to compare beautiful objects one with another not only to determine degrees of beauty, but also to discover the new beauty which such comparison may disclose.

The pursuit of beauty, furthermore, involves continued attention; a certain object may attract us at first glance because it exerts a powerful stimulus and commands

[4] Santayana, *l. c.*, p. 110.

our attention, but no casual glance will reveal beauty in it, and to appreciate that beauty to the utmost we must become absorbed in contemplation, must, as we often say, "enter fully into the spirit of the thing." This is another value attached to the study of esthetics, that it develops the power of concentrated observation.

It thus appears that the cultivation of esthetics not only tends to develop sympathy and from that as a starting-point, becomes a prominent factor in the development of idealism, but also develops judgment, power of concentrated observation, and respect for the opinions of others, being thus also a factor in the production and spread of democratic ideals. The multiplication of objects of beauty in our cities —parks, with all that usually goes with them, fine buildings, and works of art—is not extravagance, nor is it of little consequence that we seek to secure beauty in all the details of our surroundings. The effect of these things, acting gradually and exerted unconsciously upon the citizens, produces in time results which no one can measure but of the value of which there can be not the slightest doubt.

In this connection we should be reminded of the fact that esthetics is but rarely taught as such, and indeed, the daily contact with beautiful things, working silently but none the less surely, is more effective than conscious efforts to secure results, which too often defeat themselves by the opposition of the persons whom it is desired to affect. Esthetic training may be secured from the study of literature, of science, or of the arts, if care be used to take advantage of the opportunities constantly offered.

The study of animal life is peculiarly suited to form the basis of esthetic training, and, indeed, no one can acquire even a rudimentary knowledge of zoology without being influenced esthetically. There is in the case of the animal, not only the beauty of form and of color which belongs to so many natural objects, but also the beauty of motion, in the case of birds the beauty of song, and in all higher animals even greater esthetic possibilities are revealed in the degree to which their natures are akin to that of man. Animal nature study develops sympathy, judgment and the power of observation, and always excites the closest attention, thus possessing exactly the esthetical values referred to above. It is clearly opposed to all that is dogmatic, and properly presented or acquired contributes to liberality of thought and respect for the points of view of others.

In another way animal nature study is supreme among the subjects which may form the basis of training in esthetics. Just as the earliest artistic efforts of primitive man seem to show that of all the objects about him animals appear to have most attracted his attention and stimulated first his imagination, so in childhood we today are first most strongly impressed by the living animals about us. While children may be to a degree interested in trees, and flowers, and the inanimate things around them, the most effective approach to nature study in the case of younger children is through the study of animals and this is the logical beginning of esthetic training.

It thus appears, if the points which have been referred to are well taken, that the cultivation of esthetics is highly valuable to us as individuals, to the communities in which we live, to the nation of which we are a part, and to mankind as a whole, and since the study of animal life is preeminently fitted to serve as the beginning of such cultivation and is peculiarly appropriate as material for its continued prosecu-

tion, no further argument is necessary to show the esthetical value of zoology.

In inviting your attention to the other aspect of the topic assigned to me, the recreational value of zoology, it should first be noted that this does not involve entrance upon a new field. The play instinct, which is exhibited by many animals in varying degree, and which with his more complex nervous system, reaches its highest and most varied manifestations in man, is essentially an esthetic instinct.

This is most evident in the play of children. They impersonate various characters, and little girls, "playing lady" reproduce practically all the activities of their mothers—they keep house, they have and direct imaginary servants, they order by telephone articles needed in the household, they make calls, go to parties, become ill and call physicians or nurse members of the families who are sick, they go visiting, write, send and receive letters, imagine themselves afflicted by the various trials that beset married life, exchanging sympathy with one another over these troubles, and if they be not yet subject to these trials, they have lovers and enjoy the consequent notes, flowers, bonbons, invitations to the theater, and other attentions that attend such a blissful state of existence. Boys in like manner impersonate their fathers, or conceive of themselves as animals the habits of which they imitate, and even pose as inanimate objects and endeavor to reproduce the qualities they ascribe to such objects. Have none of you a memory of having played animal and a recollection of the disappointment you felt as an elephant when your more sagacious companions, who were monkeys, climbed the tree after apples and insisted on your remaining on the ground?

Thus the child puts himself in the place of the object which he sees in his imagination, and derives pleasure from the activities that that involves. That he secures from it a sensation of beauty may be questioned in many cases, but it should be remembered that children reproduce more or less perfectly such activities as seem to them attractive, such as flying and swimming, or personal qualities which they admire, that they aim to arrive at consistency in their play, and that a sense of rhythm is frequently strongly evident. Many games are accompanied by singing, and a careful study of the whole matter has led to a general recognition among estheticians of the esthetical nature of play as it is carried on by children.

In adults this is less clear. But the essence of play in adults is in the laying aside of one's ordinary character and activities and the assumption of a different character with the different activities this involves. To a greater degree than in the case of children do adults seek to realize the fullest consistency in the playing of the part and to a greater degree do these activities involve that which is really beautiful. It is interesting to note also the tendency of adults at play to break into song.

Play activities must, if they be in the fullest sense of the word play, have nothing in common with our ordinary vocations. Hunting is recreation to the business man but business to the professional hunter and guide. A hunter would enjoy less of the pleasure of the hunt if he did not wear the regulation hunting clothes and carry the paraphernalia which is appropriate to such an expedition. The charm in hunting lies in the constant stimulation of the imagination. The hunter is alert to the possibility that any moment the game may come into view and demand instant action if it be secured. Any grass-clump, any thicket, any piece of woodland, any depression, or any turn in his course may disclose

the quarry. A hunting excursion is really a constant succession of play-reactions. The killing is not pleasure, but the getting of the game gives satisfaction because it is the culmination and realization of a pursuit which has been in the fullest sense of the word, esthetic.

Not only must play activities be different from ordinary activities but the object sought must be non-utilitarian. A man who goes hunting or fishing with the sole idea of killing and bringing home all the booty he can, and, it may be, whose game is driven up to him, does not derive the recreation he might from his quest.

It is unnecessary to say that recreation must afford pleasure to him who seeks it. This element introduces the possibility of infinite variety in play, and again emphasizes its resemblance to other esthetic activities, which we have seen are individualistic in character. Two persons will find equal enjoyment in very different types of recreation, what is play to one might be the hardest of work to another, and the ways in which different individuals will pursue the same type of recreation are almost as many in number as are the individuals themselves.

The aim of play is primarily rest. We endeavor to select recreation of such a character as to demand the use of muscles ordinarily not called into activity, thus relieving those that are exhausted with the daily toil. We seek enjoyment in directions that carry us outside our ordinary field of thought and in that way afford the opportunity to tired nerve cells to recuperate their energies. We demand in our play freedom from worry and responsibility. A quality in play much emphasized by some students of the subject is that its activities are assumed voluntarily and may at any moment be suspended. How much it adds to the enjoyment of a trip if we feel that it makes no difference when we get home! Play should involve both muscular and nervous activity and should be capable of fully absorbing the attention of the player.

Finally it may be pointed out that recreation should be taken away from the familiar surroundings, is most profitable when taken in the open air, and most satisfying to a person of taste and culture, if sought amid scenes which stimulate our sense of beauty.

The ultimate aim of recreation is, as was that of esthetics, the development of a more effective individual to the ends that he may become a more worthy citizen. As each develops sympathy, the power of judgment, and of concentrated attention, they both do contribute definitely to this end. And both assist in this development in another manner which has not been mentioned. Nervous balance, the ability of an individual to maintain a clear mental vision, an active imagination, the possession of strong emotions always held in check by reason, are necessary if a man is going to be consistently a safe and progressive citizen. Both esthetics and nature study not only tend to develop this balance and these qualities, but both also offer relief from strain when one's burdens become heavy and the weight of responsibility presses hard. One person finds relief in the beauty of art, another in the beauty of literature, but many and perhaps the majority seek it in the beauty of nature in one form or another or in the relaxation and recuperation which are afforded by recreation.

That the study of animals, particularly in their natural environment, affords opportunities for recreation is so evident as to make proof unnecessary. But emphasis is given to the statement if attention is called to the fact that all the essential conditions of play are present, that it takes one away from ordinary scenes and activi-

ties, leads him into the open air, brings him in contact with interesting and beautiful objects, demands physical and mental activity, and if he be susceptible to the attraction of such objects at all, absorbs his attention, and thus relieves him from worry and responsibility.

Thus zoology has a very considerable recreational value, but it is clear from what has been said that this is to be secured in greatest degree from the study of field zoology, or as it is usually called, nature study. There is much esthetic value in the study of animals in the laboratory and museum and there is some recreational value as well, but both are realized in far greater degree if animals be studied living, in their natural surroundings, and displaying their characteristic activities.

Hunting is attractive to many men and to some women, but opportunities for such recreation are rapidly growing less and less, and over the larger part of our country are now secured only at a considerable sacrifice of time and money. Fishing is still within the reach of a larger number, but opportunities for this enjoyment are constantly diminishing. Under these conditions many sportsmen have taken to the camera and find close at hand in the pursuit and photography of animals too small to serve as game all the pleasures that they formerly found in hunting or fishing.

One feature of nature study which adds greatly to its recreational value so far as the great number of our people is concerned is that it may be pursued close at hand. The out-of-doors is all around us, but most of us see little of it. Let one take up the pursuit of nature study and everything about him takes on a different aspect. Where before he saw only earth and sky and woods and fields, now he sees a myriad of beautiful and interesting forms. His eyes are opened to objects and activities before undreamed of and not only does the thicket and weed-patch, pond and stream, become scenes of marvelous activity, but the air is vibrant with tones before unheeded. The activities of the animals here as in the case of esthetics give to animal nature study a peculiar value as compared with the study of plants or inanimate nature.

And as the study is pursued the surroundings become pregnant with more and more of interest and beauty. Every walk becomes an adventure and every area to which one devotes his attention a field of discovery. It has been said that to secure the greatest value from recreation one must seek new scenes and such as afford opportunities for the contemplation of the beauties of nature. To the student of nature study the most familiar scenes take on a new aspect, and as his knowledge increases he not only learns how to find new and beautiful objects, but he acquires also that which enables him to project himself into features of his surroundings which before seemed commonplace and uninteresting. These now appear beautiful and to opportunities for healthy recreation are added means of esthetic enjoyment which can be but slightly appreciated by those who have never experienced them. Nay more—as nature is infinite, and as he is capable of continued development, a lifetime of ever-widening opportunity unfolds itself as he proceeds.

It may seem a far cry from the tumult of battle to the calm and peace of the roadside, the meadow and the woods; from the broad principles for which nations are contending to the simple facts of nature study; from a field of struggle which involves the whole world to the area limited by one's horizon. But a little consideration shows

that it is not so far, after all. From the highways and byways from one end of this country to the other are coming the men who are to fight the battle for freedom; in last analysis the idealism for which this nation stands is rooted in the minds of its people; and the extent to which the government can prosecute the war, it may be even victory itself, depends upon the strength of that idealism in the minds of even the most humble and least traveled of our citizens.

But after the war will come peace, when we will resume to a large degree our former daily habits of life and thought, when the communities in which we live will once more take up the tasks of civic and industrial development, when our nation will turn again to those problems of government and society upon the successful solution of which its future prosperity, if not its existence, depends. Then will be needed more than now the idealism which a crisis like the present calls forth in such strength, but which slumbers in time of peace; then will we need to consider most seriously the means by which that idealism may be developed and kept active. Then will democracy even more than at the present time need to be fostered and will we need to make use of every agency which will educate people to a broader view of their responsibilities and increase sympathy, the love of truth, right and justice, regard for the welfare of others, and a feeling of kinship with all mankind. And if the study of animal life can contribute even in a small degree to the effectiveness of our people and to the development of that idealism upon which the future of democracy depends, then is it worthy of consideration and the value of zoological science has one more claim to recognition.

R. H. Wolcott

University of Nebraska

SCIENTIFIC EVENTS

TIN IN VIRGINIA

The United States is almost entirely dependent on foreign countries for its supply of tin. As this metal is a war-time necessity, and as a domestic source of supply is urgently needed, all known deposits of tin ore (cassiterite) in the United States have recently been examined by geologists of the United States Geological Survey, Department of the Interior. One of the most promising of these deposits is in the Irish Creek district, in the eastern part of Rockbridge County, Va., near the summit of the Blue Ridge. This deposit was recently examined by H. G. Ferguson, of the United States Geological Survey, which in this research is acting in cooperation with the Virginia Geological Survey. The existence of tin ore in the Irish Creek district has been known for many years, and between 1883 and 1893 the deposit there was actively mined. The mining company, however, became involved in litigation as to land titles and abandoned work in 1893. Work on the deposit was never resumed, and the old workings are now caved and heavily overgrown with brush, so that a thorough examination of them is difficult, but what Mr. Ferguson saw in the field and the information he derived from old reports led him to conclude that the deposits along the Blue Ridge in this vicinity offer some promise as a source of tin, both through the systematic working of the known veins and the possible discovery of other deposits. The cassiterite occurs in quartz veins that cut a granitic rock of peculiar appearance known as a hypersthene granodiorite. The veins do not continue for long distances and their content of tin is probably very irregular from place to place. Some high-grade ore was found, however, and some tungsten ore occurs with the cassiterite. It is believed that the district is worthy of further investigation. A copy of the report may be secured on application to Dr. Thomas Leonard Watson, director, Virginia Geological Survey, Charlottesville, Va.

INTERNATIONAL SCIENTIFIC NOMENCLATURE[1]

In the *Comptes rendus* of the Paris Acad-

[1] From *Nature.*

emy of Sciences for February 11 there is a manifesto in the form of a memorandum entitled "Observations on Modern Scientific Language" by a number of French men of science, MM. Bigourdan, Blondel, Bouvier, Branly, Douvillé, Guignard, Haller, Haug, Henneguy, Lacroix, Lallemand, Laveran, Lecomte, Lecornu, Lemoine, Maquenne, Emile Picard, Roux, Schloessing, jun., and Tisserand. The writers of this note enter a protest against a tendency they have observed on the part of the younger generation of scientific workers both to neglect literary form in their publications and to introduce new and strange words which are often unnecessary or badly constructed.

It is suggested that youthful authors may perhaps think that the use of outlandish expressions lends an air of learning to their communications, whereas the impression sometimes produced upon the reader is that he has come upon a bad translation of a work originally published in some foreign language.

It is pointed out that, owing to the international character of science, words and expressions which are quite appropriate in one language have been transferred bodily into another language without proper steps having been taken to adapt them to their new home. For example, our words "control" and "to control" have been translated "contrôle" and "contrôler." But "contrôler" means "to register," and, therefore, ought not to be used in the sense of "to regulate" or "to exercise an influence over." The English expression "self-induction" sometimes appears in French papers on electricity in the shortened form of "le self." Even an Englishman would find it difficult to discover the meaning of such an expression, so that a Frenchman may be pardoned if he finds it barbarous.

The writers of the note express the hope that the more closely the bonds between the Allied nations are drawn, the more care may be taken in translating scientific terms and expressions. It is suggested that international congresses and all forms of international cooperation afford a means of "controlling" the international language of science.

APPLIED PSYCHOLOGY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY AND ITS WAR-TIME WORK

Dr. Guy M. Whipple has resigned from the University of Illinois to accept appointment at the Carnegie Institute of Technology as professor of applied psychology and director of educational research. During the present year, Dr. Whipple has been in Pittsburgh part time as acting director of the Bureau of Salesmanship Research during the absence of Dr. Walter Dill Scott, who since last July has been in Washington as director of the Committee on Classification of Personnel in the Army. Dr. Whipple will continue as acting director of the Bureau of Salesmanship Research as long as Dr. Scott is engaged in war work. He will then enter on his duties as director of educational research and will carry forward scientific studies in engineering and technical education as they arise in the administration of instruction at the Carnegie Institute of Technology.

Announcement is made of the promotion to the rank of associate professor of Dr. James Burt Miner, who is acting as head of the division of applied psychology at the Carnegie Institute of Technology during the absence of Dr. W. V. Bingham on war work in Washington. Dr. L. L. Thurstone has been advanced to the rank of assistant professor. Dr. A. J. Beatty, assistant to the director of the Carnegie Bureau of Salesmanship Research, will on June 1 become director of education of the American Rolling Mills Company, at Marietta, Ohio. Dr. Kate Gordon has been granted leave of absence from the Carnegie Institute of Technology for the fall quarter to enable her to carry out for the California State Board of Control a psychological investigation of children who are wards of the state.

Dr. Beardsley Ruml has been given leave of absence from the Carnegie Institute of Technology to devote his full time to the direction of the work of the Trade Test Standardization Division of the Committee on Classification of Personnel in the Army. Dr. L. L. Thurstone has been granted half-time leave for similar work. Dr. T. J. Kirby has been granted

half-time leave from the University of Pittsburgh and is working with Dr. Thurstone, Mr. L. C. Toops, of the University of Ohio, and Dr. J. Crosbey Chapman, who is in charge of the Pittsburgh station of this Trade Test Standardization Committee. The purpose of these standardized trade tests is not to discover which trade or occupation a soldier should be trained to follow. It is rather to measure the degree of trade skill which his industrial experience has already given him. The question is not one of "guidance" but of assignment of men to those duties of a technical sort which their civilian occupations have already equipped them to follow to advantage in the Army. Oral and performance tests of carpenters, pattern makers, vulcanizers, automobile engine repairmen, truck drivers, electricians, etc., have been developed, standardized and introduced into Army procedure. Tests for skill in more than a hundred other trades of importance in a modern army remain to be developed and standardized. About twenty mechanical engineers, civil service experts, employment managers and psychologists are engaged in the preparation and standardization of these trade tests, working under the immediate supervision of Dr. Ruml, at Newark, New Jersey, and under the more general direction of Dr. Bingham who is executive secretary of the Committee on Classification of Personnel in the Army, with headquarters in the office of the Adjutant General at Washington. Installation of the trade tests in the Army camps is in charge of Mr. E. M. Hopkins, employment director of the General Electric Company.

PRESENTATION OF THE EDISON MEDAL

ACCORDING to the account in the *Electrical World* a large audience, gathered in the Engineering Societies Building, New York, at the annual meeting of the American Institute of Electrical Engineers on May 17, witnessed the presentation of the eighth Edison medal to Colonel John J. Carty of the United States Army Signal Corps, chief engineer of the American Telephone & Telegraph Company. The award of the medal to Colonel Carty for his work in the science and art of telephone engineering has already been announced in SCIENCE. Those to whom the medal has been awarded in previous years are Elihu Thomson, Frank J. Sprague, George Westinghouse, William Stanley, Charles F. Brush, Alexander Graham Bell and Nikola Tesla.

Dr. A. E. Kennelly, professor of electrical engineering at Harvard University and Massachusetts Institute of Technology, told of the history and significance of the medal. Dr. Michael I. Pupin of Columbia University said: "Carty's life is filled with romance. He never went to college. At the age of eighteen, when other boys entered college, he entered the service of the American Bell Telephone Company and at the age of twenty-eight became chief engineer of the great New York Telephone Company." E. W. Rice, Jr., president of the Institute, made the formal presentation of the medal. In accepting the medal Colonel Carty gave credit for the American telephone achievements to the engineers who have been associated with him in the Bell system and paid a tribute to Major-General George O. Squier, chief signal officer of the United States Army.

The newly elected Institute officers, who serve during the administrative year beginning on August 1, 1918, were the directors' nominees, as follows:

President—Professor Comfort A. Adams, Harvard University and Massachusetts Institute of Technology, Cambridge, Mass.

Vice-presidents—Allen H. Babcock, San Francisco; William B. Jackson, Chicago; Raymond S. Kelsch, Montreal; F. B. Jewett, New York; Harold Pender, Philadelphia; John B. Taylor, Schenectady, N. Y.

Managers—G. Faccioli, Pittsfield, Mass.; Frank D. Newbury, Pittsburgh; Walter I. Slichter, New York.

Treasurer—George A. Hamilton, Elizabeth, N. J.

SCIENTIFIC NOTES AND NEWS

AT the ninety-fourth annual commencement of the Rensselaer Polytechnic Institute, the degree of doctor of engineering was given to Lieutenant Colonel Henry W. Hodge, U. S. engineer, manager of roads, American Expe-

ditionary Force in France; to Alexander C. Humphreys, president of the Stevens Institute of Technology; to Edwin W. Rice, Jr., president of the General Electric Co.; to William Hubert Burr, professor emeritus of Columbia University, and to Onward Bates, of Chicago. The degree of master of civil engineering was conferred on Francis E. House, president of the Duluth & Iron Range Railroad.

At the commencement of Colgate University the honorary degree of doctor of science was conferred on Professor Clarence A. Martin, dean of the college of architecture of Cornell University.

Harry Lee Huber, formerly pathologist in the University of Chicago, was awarded the Ricketts Prize on May 2, on account of his research work to determine new methods of treating tuberculosis. The prize consists of the income of $5,000 and is given in memory of the late Dr. Howard Taylor Ricketts.

Mr. F. E. Kempton, who receives his doctorate in plant pathology at the University of Illinois, this spring, has been appointed as pathologist to the Porto Rican Agricultural Experiment Station. He will leave for Porto Rico at once, where his address will be Mayagüez.

Professor James H. Bonner, of the faculty of the school of forestry at the State University of Montana, has completed his training at Camp Lee, Virginia, where he received a commission as captain in the engineering corps.

Mr. John H. Card, teacher of chemistry at the high school, Brockton, Mass., has joined the Chemical Service Section of the National Army. He has been assigned to the offensive research investigations at the American University Experiment Station, Washington, D. C.

Dr. Benjamin T. Terry has resigned his place as director of the Brooklyn laboratories of pathology of the Charities Department. He is reported to have said that he was not a politician, but a teacher, and conditions had become such that he thought it better to resign.

Ira A. Williams, formerly with the Iowa Geological Survey, and for the past five years ceramist and geologist for the Oregon Bureau of Mines and Geology, has asked to be relieved from his duties in connection with the bureau for the present field season in order to take charge of the development of large ranch interests in the Sacramento valley of California. Mr. Williams also relinquishes the professorship of ceramic engineering in the Oregon School of Mines at Corvallis at the close of the present college year.

Professor C. H. Eigenmann, of Indiana University, has resigned as curator of ichthyology in the Carnegie Museum, the resignation to take effect on June 1.

Professor Ernest Haeckel, the distinguished German zoologist and exponent of the Darwinian theory, is reported by the German newspapers to be in failing health. On his eighty-fourth birthday, he is said to have sent to his friends an engraved birthday card, bidding them farewell.

The University of Pennsylvania Museum has dispatched an expedition to South America under the leadership of Mr. Theodoor de Booy, assistant curator in the American Section of the museum, to explore the Sierra Pareja range of mountains in Venezuela not far from Lake Maracaibo. This high range of mountains which juts into Colombia is unexplored and the character of its natives unknown.

The station at Green River, Wyoming, for the observation of the total eclipse of June 8 by the party from the Yerkes Observatory, University of Chicago, has been named "Camp Charles A. Young," in honor of the eminent American spectroscopist of solar eclipses. The program of observations to be undertaken includes: Direct photography of the corona with 60-foot coelostat and with 12-inch equatorial telescopes: spectroscopic investigation of the flash spectrum, in the infra-red with a small concave grating, and in the violet with camera using a "movie" film for quick succession exposures; photography of the coronal spectrum with prismatic cameras and with a slit-spectro-

scope; photometric work both visual and photographic; a photographic record of the successive stages of the eclipse with a "movie" machine provided with a "Euryscope" doublet lens of 25 inches focal length. The scientific staff at the station on May 20, were Messrs. Frost, Barnard, Parkhurst, Barrett and Miss Calvert. By June 3, others participating in the work will include Miss Lowater, of Wellesley College, Miss Wickham, Mrs. Parkhurst and Mr. Blakslee, of Yerkes Observatory. Dr. George S. Isham, of Chicago, and Professor C. C. Crump, of Ohio Wesleyan University and L. A. H. Warren, of Winnipeg. Weather conditions are now promising fairly at the station. The station from the Mount Wilson Solar Observatory is being established about a thousand feet from Camp Charles A. Young, which is situated under the buttes at the outskirts of the town of Green River on the main line of the Union Pacific Railroad.

FREDERICK REMSEN HUTTON, honorary secretary of the United Engineering Society and long dean of the faculty of engineering at Columbia University, has died in his sixty-fifth year.

ALONZO COLLIN, Sc.D., died in his eighty-second year on April 16. Dr. Collin was a graduate of Wesleyan University in 1858, and served Cornell College from 1860 until 1906, when he was made professor emeritus, retiring upon the Carnegie Foundation. His first chair was that of the natural sciences and later physics.

THE seventh lecture of the series on science in relation to the war was delivered at a joint meeting of the Washington Academy of Sciences and the Chemical Society on May 15, by Dr. Arthur A. Noyes, professor of theoretical chemistry at the Massachusetts Institute of Technology, and chairman of the Nitrate Committee. The subject of the lecture was "The nitrogen problem in relation to the war."

A SPECIAL meeting of the Engineering Foundation was held on May 28 in the auditorium of the Engineering Societies Building in New York. Dr. George E. Hale addressed the meeting on the "National Research Council." The foundation is composed of representatives of the national societies of Civil, Mining, Mechanical and Electrical Engineers.

PROFESSOR COMFORT A. ADAMS, president of the American Institute of Electrical Engineers, and professor of electrical engineering at the Massachusetts Institute of Technology, was the main speaker at the annual meeting and dinner of the Schenectady Section of the institute on May 24.

THE address of Mr. William H. Babcock as retiring president of the Anthropological Society of Washington was delivered on April 23 and entitled "Some ethnological and national factors in the present war."

PROFESSOR ROBERT M. OGDEN, of Cornell University, delivered the commencement address at the University of Tennessee on May 29.

PROFESSOR WILLIAM T. SEDGWICK, of the Massachusetts Institute of Technology, delivered the commencement address at the Boston School of Physical Education on May 23.

THE annual spring meeting of the Eastern Association of Physics Teachers was held in the Salisbury laboratories of the Worcester Polytechnic Institute on May 25. Among the speakers at the meeting were Dr. Samuel J. Plimpton, instructor in physics, Worcester Polytechnic Institute; Clarence D. Kingsley, of the State Board of Education, and Dr. Gordon Webster, professor of physics at Clark University and a member of the Naval Consulting Board.

THE thirty-fifth annual meeting of the American Climatological and Clinical Association will be held in Boston on June 5 and 6, under the presidency of Captain J. Elliott, C.A.M.C., Toronto, Ont. The session of the association will be held at the Boston Medical Library, the Fenway.

THE annual joint conference of the United States Public Health Service with state and territorial health officers, will be held in Washington, June 3 and 4. The *Journal* of the American Medical Association states that the sanitation of extracantonment areas will be one of the chief subjects on the program. Reports will be made as to the success of the

cooperative arrangement developed during the past year for preventing the interchange of disease between civil and military populations. Among the subjects to be discussed are the relation to public health of industrial hygiene and sanitation, especially in war industries; the care of the health of tuberculous soldiers on their return to civil life; the use of records of drafted men for public health purposes; effects on the public health of the forthcoming shortage in the medical profession. Among the subjects not so closely related to the war are: the securing of better morbidity reports, and the question of pure water supplies for railroads. There will be reports of standing committees in regard to many of the subjects outlined above and in regard to the sanitation of public conveyances, rural sanitation, and increasing the efficiency of the conferences. The sessions will constitute the sixteenth annual conference of state and territorial health authorities with the United States Public Health Service.

The Paris Academy of Sciences has formed a new division for applied science which is to consist of six members.

Simmons College announces the graduation in May and June of specially trained women to serve as secretaries in hospitals and dispensaries, or to private physicians. Their training includes all the technical secretarial work and in addition a knowledge of medical terms, scientific German and general and special science as applied in the diagnostic laboratory.

The American Association of Clinical Psychologists was organized at Pittsburgh on December 28, 1917. The membership includes persons holding the doctorate in psychology, who are engaged in the clinical practise of psychology in the United States. The forty-five charter members are chiefly directors of clinics, of bureaus of child welfare, of institutional laboratories; engaged in army service, as mental examiners of recruits and officers; or connected with courts, hospitals and schools. The objects of the association are to promote an *esprit de corps* among psychologists who have entered the practical field, to provide media for the communication of ideas, to aid in establishing definite standards of professional fitness for the practise of psychology and to encourage research in problems relating to mental hygiene and corrective education.

The biological station of the University of Michigan will hold its tenth session this summer during the eight weeks from July 1 to August 23, inclusive. This station is situated on the shores of Douglas Lake in the northern part of the southern peninsula of Michigan, about equidistant from Petoskey, Mackinaw City and Cheboygan. The personnel of the teaching staff is as follows: In zoology, George R. La Rue, of the University of Michigan, Max M. Ellis, of the University of Colorado, and Paul S. Welch, of the Kansas State Agricultural College in botany, Henry Allan Gleason and John H. Ehlers, of the University of Michigan, and Frank C. Gates, of Carthage College. Roland F. Hussey and Glenwood C. Roe will serve as assistants in zoology, and Mrs. Max M. Ellis will be dean of women. The courses offered deal with the natural history, classification and ecology of plants and animals and are of necessity given almost entirely in the field. Opportunity for investigation is offered to a limited number of investigators upon the payment of very nominal fees. For further information regarding the station and the possibilities for biological work offered there make inquiry of George R. La Rue, director, Ann Arbor, Michigan.

The Scottish Geographical Magazine states that a curious minor effect of the war is the possible recrudescence of indigenous malaria in England, to which attention is called in a circular issued by the Local Government Board. It is well known that anopheline mosquitoes are found in various parts of England. Numbers of men who have contracted malaria during the course of the fighting on the eastern fronts have returned home, and as their blood contains the malarial parasite, and the carriers exist in this country, these men may serve as foci of infection for the civilian population. Some cases of indigenous malaria have been already recorded in England, which probably

originated in this way, and the board is making inquires as to the local prevalence of the carrier mosquitoes, and taking other precautions in regard to the disease.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Illinois college of medicine announces that, beginning with June 3, it will operate on the quadrimester system. In this system there will be three terms of four months each per calendar year. The courses will be so arranged that it will be possible for a student to enter the school at the beginning of any one of the three terms.

AFTER September of this year at Columbia University the doctorate of medicine of the medical school will be conferred only upon men who have had, in addition to four years at the medical school, one full year of service at a hospital under faculty supervision.

DR. WILLARD J. FISHER, at present honorary fellow in physics at Clark University and lecturer in physics at Worcester Polytechnic Institute, goes to Manila as assistant professor in physics at the University of the Philippines, with duties to begin about July first.

MR. KIRTLEY F. MATHER has resigned his position at Queen's University and has accepted the professorship of geology at Denison University, Granville, Ohio.

DR. FRANCIS M. VAN TUYL, assistant professor of geology and mineralogy in the Colorado School of Mines, has been promoted to an associate professorship.

DAVID D. LEIB has been promoted from associate professor to a full professor of mathematics in Connecticut College, New London.

DR. GEORGE A. BAITSELL, instructor in biology in Yale College, was appointed an assistant professor of biology at the March meeting of the Yale Corporation.

MR. WALTER S. BEACH, who will take his doctorate with his thesis in plant pathology this coming commencement, at the University of Illinois, has been appointed as instructor for plant pathological research in the Pennsylvania State College. He will have charge of a separate laboratory located near Philadelphia and is to take up his work at once.

MR. PAUL F. GAEHR, who spent the past year in research at Cornell University, will next year resume charge of the physics department at Wells College.

DISCUSSION AND CORRESPONDENCE

PROFESSIONAL COURTESY

IN the March 8, 1918, number of SCIENCE there appeared from Professor McCollum and Miss Nina Simmonds a reply to Professor Hart's statement on professional courtesy in SCIENCE, March 1, 1918. As the former introduce a question of veracity in a statement concerning me and as they express an eagerness to be judged on "research records" I feel it my duty for the enlightenment of the public to call attention to evidence furnished by such "research records."

It is significant that the article published by Professor McCollum and Nina Simmonds as coming from the Laboratory of Agricultural Chemistry of the University of Wisconsin and to which Professor Hart referred as not indicating proper authorship, was published without the legend "Published with the permission of the Director of the Wisconsin Experiment Station." All publications coming from this station are required to have this official stamp of approval. That the authors complied with this regulation for years and violated it in this and two other recent contributions, is truly significant.

It is also significant that the said authors have not given proper credit to this institution for work done by them at Wisconsin. There has appeared in the February, 1918, number of the *Journal of Biological Chemistry* an article purporting to come as a contribution by E. V. McCollum and N. Simmonds from the Laboratory of Biochemistry of the School of Hygiene and Public Health of the Johns Hopkins University. The article was received for publication December 26, 1917, only twenty-five weeks after the authors, E. V. McCollum and N. Simmonds, had severed their official connection with the University of Wisconsin, yet in this article there were published as bona fide new contributions thirteen growth curves of rats extending over periods of twenty-eight

to forty-three weeks. One curve of growth of forty-three weeks is but a continued curve of thirty weeks stated by Professor McCollum in the *Journal of the American Medical Association* of May 12, 1917, as having been presented by him before the Harvey Society, January 13, 1917. This experiment has actually been completed at least eleven weeks before Professor McCollum left the University of Wisconsin. In fact some of the curves bear a serial number and legend the same—and none bear a higher or lower serial number—as curves of similar experiments previously published by him from this institution.

Again it is significant that Professor McCollum upon severing his relations with the University of Wisconsin removed from the campus all station records accumulated by him, and some of those of other members of the staff, without the permission or knowledge of the staff, or administrators. It is recognized that a university professor doing research work on his own initiative and on his own problems is entitled to the exclusive possession of his notes, but no such *exclusive* right is recognized in the case of experiment-station workers even to their own notes on continuing projects carried out under federal grants for an indeterminate period.

Whatever may be said in denial, these are the facts. The first two are directly supported by evidence submitted in articles published by the aforementioned authors themselves. The third, first mentioned in Professor Hart's statement, they have already not seen fit to deny.

Except for the purpose of bringing out, for the benefit of those who may be concerned in the future, not only a case of transgression of professional courtesy but of professional ethics as well, the writer is not inclined to present arguments in his own behalf, especially in a matter of such small personal moment as credit for the scientific article. For the major portion of the time while the vitamine preparations in the research in question were being made and their stability was being tested Professor McCollum did not even know what was being done, or how it was done; he fed the rats. In fact, the 1916 report of the Director of the Wisconsin Experiment Station gives the writer of this note exclusive credit for activities in this field.

My acquaintances know full well what Professor McCollum's real personal opinion of me was before his transgressions, in an attempt to hamper further experimental work, called forth deniable but unrefutable charges. In place of a lengthy presentation of details actually called for by the indirect question aimed at my veracity and Professor Hart's veracity, but really best forgotten, there have been presented a few general facts in *final* answer instead.

H. Steenbock
University of Wisconsin

To the Editor of Science: Please accept my thanks for submitting to me the attack upon my character by Mr. Steenbock, in order that my reply may be printed together with it. I do not care to be a party to an undignified dispute over the question of the accuracy of the accusations which are contained in this letter, and shall not attempt an elaborate explanation of details. For the benefit of such readers as are not familiar with the original publications of Hart, Steenbock and myself, which will, I feel assured, suffice to prevent my colleagues in the field of biochemistry from giving any serious consideration to this matter, I shall present, briefly, a few facts which will enable them to see the matter of this controversy in its proper perspective. I shall hereafter take no notice of further utterances of this character. Any one who will take the trouble to examine the publications which have emanated from the laboratory of agricultural chemistry of the University of Wisconsin during the last ten years can easily form an opinion for himself as to who was initiating the work in nutrition investigations during that period.

When I left the University of Wisconsin in the summer of 1917, I took with me all the records of the experimental work with my rat colony but not any notes other than my own. No one who had not been closely identified with the work could possibly have correlated the many results, some of which were worthy of

publication, and others, for one reason or another, not satisfactory from which to draw conclusions. Furthermore, it will be generally conceded that no one but the experimentor himself has the right to the interpretation of his data, for he must be responsible for the correctness of such interpretation.

I find on reexamination of the charts in the paper by Miss Simmonds and myself in the *Journal of Biological Chemistry*, 1917, XXXIII., p. 303, that several of the curves of growth were secured in experiments carried out before our removal to Baltimore. I regret that mention was not made of this fact. Most of our papers contain data which was not secured from a series of experiments carried out simultaneously. The later experiments are in most cases planned in the light of the outcome of the earlier ones, the work being continued until a complete demonstration of some principle is secured. No injustice was intended or will in future be done to the University of Wisconsin by withholding proper credit for the facilities which made the work possible. The serial number of an experiment signifies the period when a certain ration was planned and entered in our notes and does not throw any light on when the feeding trial was made.

In 1907 I began to build up my rat colony at the University of Wisconsin for the purpose of studying the problem of the cause of the failure of young animals to grow when restricted to diets consisting of purified proteins, starch, sugars, fats and suitable inorganic salt mixtures. No one in this country at that time had any interest in the enterprise except myself. My first publication describing this work appeared in 1909, and antedated that of any other of similar character by two years. It required five years of fruitless experimenting before the first important observation was made which gave a clue to the solution of the problem. In 1912, Miss Davis and I first observed the peculiar growth-promoting properties of butter fat. We had a ration which we supposed consisted of food substances essentially pure, with which we could induce growth when butter fat was included to the extent of five per cent., whereas the same food mixture containing such a fat as olive oil or lard did not induce any growth. For a time we believed that butter fat contained the only chemically unidentified dietary essential necessary for the promotion of growth or the maintenance of health in a mammal. By 1915, Miss Davis and I, after making several hundred experimental feeding trials variously modified, were forced to the conclusion that a second unknown dietary essential had been contained in the 20 per cent. of supposedly purified milk sugar, which had formed a constant constituent of many of our early diets; we thereupon propose a new working hypothesis concerning what constitutes an adequate diet. This postulates the necessity of two dietary essentials of unknown chemical nature.

After a long series of experiments planned to show the distribution of these two substances in natural food-stuffs, it was found that one of them is associated with certain fats, whereas the other is never associated with fats of either animal or vegetable origin. The latter is soluble in water, the former readily soluble in fats. Miss Kennedy and I, therefore, proposed the terms fat-soluble A and water-soluble B as provisional names pending such a time as we should learn enough about their nature to be able to give them names which would be suited to their peculiar structure, and fit in with the nomenclature of organic chemistry.

About two thousand feeding experiments have now been completed, each lasting between six weeks and two years. These were all interpreted in the light of our working hypothesis described above, and also in the light of the composition of the proteins as revealed by the studies of Fischer, Abderhalden, Osborne and others, and have made clear the nature of the dietary deficiencies of several representatives of each of the several classes of natural foods, seeds, tubers, roots, leaves, meats, eggs and milk. These results have made possible important generalizations, which must eventually lead to great improvement in the health of large groups of peoples who are now suffering

from malnutrition, due to their living on poorly constituted diets, and also to greater efficiency in the use of feeding-stuffs in animal production.

Our solution of the problem of successfully feeding diets of purified foodstuffs together with the two unidentified food essentials, fat-soluble A and water-soluble B, greatly simplified the study of the problem of isolating the latter substances. Indeed without it the study of this problem can scarcely succeed. My associates and I have further simplified the problem of their isolation by the demonstration that similar "protecting" substances do not exist for the diseases scurvy and pellagra. It had become a widely accepted belief that there existed not less than four such unknown dietary essentials, one for the prevention of beri-beri, another each for scurvy, pellagra and for rickets. This belief rested on the "vitamine" hypothesis of Funk. I need not here dwell upon the important studies of Eijkmann, Fraser and Stanton, Stepp, Holst, Funk, Williams, Osborne and Mendel, and of Goldberger, a critical study of whose papers greatly aided us in the planning of our experimental diets and in the interpretation of our results.

During my stay at the University of Wisconsin nobody had anything to do with independent work with my rat colony, except in a small way an independent study was carried on by Mr. V. E. Nelson during the months just preceding July, 1917. I reiterate my statement in my reply to Professor Hart in SCIENCE for March 8, that the work which they charged I had made dishonest use of, which was participated in by Mr. Steenbock, was planned entirely by me, and was carried out by him as directed, in the capacity of an assistant. He was not consulted about the interpretation of the data in the paper by McCollum and Simmonds (*Jour. Biol. Chem.*, January, 1917), because his personal attitude towards me before I left Wisconsin made impossible a joint preparation of the paper, and he was therefore given credit for the preparation of the materials employed in the experiments instead of being made joint author, as I should have been glad to have made him under other circumstances.

When one leaves an institution after having made observations of a fundamental character, and having for several years made use of these in the development of new and important lines of research, his colleagues who remain behind have, of course, a right to continue investigation in this field, just as any one located elsewhere has the right to take advantage of the observations of others, and attempt to further the acquisition of knowledge. There is no property right in research or its results so long as it is incomplete and not protected by patent. Some proceed on this theory, attempting the while to perfect details, and to add some element of originality, and to give their work the mark of independent thought. Others prefer to spend their time in making experiments of an exploratory character, at the risk of doing much unprofitable work in order to make some observation which will open up a new field of investigation which they may follow with profit. A few prefer to attempt to bring into disrepute some investigator who has opened up a new field of research when he has reached a point where much further work remains to be done, which is obvious to every one who studies his published results, in the hope that they may thereby so discredit him that his work will be interfered with, with a view to making possible the reaping of a harvest of opportunity which his absence from the field would make possible. Many believing that the author of the first important observation has the right to be allowed to develop the new field without annoyance, refuse, from a sense of self-respect, to pounce upon, and, in haste, complete what another is doing, when a study of fundamental nature makes possible a new type of investigation. Judgment as to which course one should pursue will, of course, be determined by the standards of the individual.

E. V. McCollum

BALTIMORE, MD.

THE WORLD'S CALENDAR

TO THE EDITOR OF SCIENCE: A communication by W. J. Spillman in SCIENCE of May 17 discloses the fact that a bill was introduced in the Congress on April 16 with the object of

reforming the world's calendar, by Honorable J. M. C. Smith, of Michigan.

It is gratifying to learn that the movement for Calendar Reform is thus taking on definite shape; and also that, from the writer's viewpoint, the bill referred to embodies the feature of dividing the year into thirteen lunar months, thus assigning to the moon her rightful place in determining her share of time division in the calendar.

It would appear to be sufficiently obvious without special mention, that it must be futile for any individual government to undertake a reform of the world's calendar without the cooperation of the other principal civilized nations; and that any legislation that may now be projected along that line should be with the object of securing such cooperation.

It may be suggested also that the movement might better be deferred until the present world agitation shall have subsided.

T. G. DABNEY

CELLULOID FOR COVER GLASSES

TO THE EDITOR OF SCIENCE: War conditions are causing many substitutes to be used, and even I was forced to one by the scarcity of cover glasses for microscopic work. I found that sheet celluloid can very well be used in place of the glass, the fiber thereof being practically negligible for beginning work. I take sheet celluloid, cut strips about the width of the slide, iron these strips flat (place the heated iron over each part but do not rub, for rubbing the iron causes other streaks), and then cut the strip into small squares. In addition to being unbreakable and so quite durable and inexpensive, they can not scratch the lens by the pupil running the objective into the coverslip, as beginners are prone to do with all cautions about such dangers forewarning them. Other science teachers may find this expedient worth trying.

F. A. VARRELMAN

LOWELL HIGH SCHOOL,
SAN FRANCISCO, CALIF.

AN ABSOLUTE SCALE FOR RECORDING TEMPERATURE

TO THE EDITOR OF SCIENCE: I think the suggestion of Dr. Marvin in a recent number of SCIENCE (15 March, 1918) with reference to the adoption of an approximation to the absolute scale of recording temperatures is a good one. Two suggestions occur to my mind in trying to devise an appropriate name for this scale. As it is a combination of the Absolute and the Centigrade the word "Abcent" composed of the first syllable of each word seems to give a fitting term. An alternative would be to call it the "Thomson" scale, a name which would signify that it closely resembles the Kelvin or absolute scale but is not quite the same. As is well known, Lord Kelvin's earlier name was Sir William Thomson.

J. ADAMS

CENTRAL EXPERIMENTAL FARM,
OTTAWA, CANADA

SCIENTIFIC BOOKS

Calculus. By HERMAN W. MARCH, Ph.D., Assistant Professor of Mathematics, University of Wisconsin, and HENRY C. WOLFF, Ph.D., Assistant Professor of Mathematics, University of Wisconsin. McGraw-Hill Book Company, New York, 1917. Pp. xvi + 360.

Differential and Integral Calculus. By CLYDE E. LOVE, Ph.D., Assistant Professor of Mathematics, University of Michigan. The Macmillan Company, New York, 1916. Pp. xviii + 343.

Plane Trigonometry with Tables. By EUGENE HENRY BARKER, Head of the Department of Mathematics, Polytechnic High School, Los Angeles, California. P. Blakiston's Son and Co., Philadelphia, 1917. Pp. 172.

College Algebra. By ERNEST BROWN SKINNER, Assistant Professor of Mathematics, University of Wisconsin. The Macmillan Company, New York, 1917. Pp. vi + 263.

Projective Geometry. By L. WAYLAND DOWLING, Ph.D., Associate Professor of Mathematics, University of Wisconsin. McGraw-Hill Book Company, New York, 1917. Pp. xiii + 215.

Elliptic Integrals. By HARRIS HANCOCK, Professor of Mathematics in the University of Cincinnati. John Wiley and Sons, New York, 1917. Pp. 104.

Of the making of many text-books of mathematics for colleges and secondary schools there

is not only no end but no very evident diminution. The phenomenon is interesting, especially in view of the gravity of the times so unfavorable to the customary pursuits of scholars. No doubt the explanation involves a wide variety of considerations. One of these is the purely commercial competition among publishers who invite cooperation of teachers in the making of books. Another is the fact of a certain inertia acquired before the war: for example, no less than four of the above-listed volumes belong to series of publications initiated in times of peace or at all events prior to the entry of the United States into the world conflict. A third consideration relates to numbers: the number of persons in the country who are devoted to the teaching of mathematics or to mathematical research or to both is large; it is absolutely large and it is large relatively to the number of those similarly engaged a generation or two ago; the membership of the American Mathematical Society includes more than seven hundred; that of the recently organized Mathematical Association of America, more than a thousand; and there are in various sections of the country other flourishing associations of teachers of mathematics: it goes without saying that where there are many persons competent to write books many books will be written.

No doubt the more intimate personal motives to the writing of mathematical text-books are various. The hope of pecuniary reward is probably not very effective, at least not effective with many, if by hope we are to understand desire plus expectation. What may be called the reputational motive is doubtless more powerful: there is a general expectation that college and university instructors will be productive scholars; owing to a variety of circumstances the production of text-books is apt to seem an easier, albeit a less effective, way to meet such expectation than is the way of research. Then there is the altruistic motive—the impulse to serve; it is certain that this motive is frequently present and sometimes dominant: mathematical text-books are sometimes written to advance the cause of mathematical education. It is probable that the principal motive to the kind of activity in question is really hedonic, consisting in the peculiar pleasure that is felt in trying to perform an approved task of great difficulty or—to view the matter in another aspect—in trying to win, in competition, an exceedingly difficult game. Surely there is here ample room for the play of that motive, for it is not easy to imagine an undertaking more beset with difficulties than is the writing of a mathematical text-book that is to be at once excellent in quality and successful in its appeal for public approval. The suffrages of teachers must be won. But teachers vary enormously in respect of scientific competence. The extremes are widely sundered. One of them is represented by the reactionaries, by those whose knowledge is less a knowledge of subject-matter than of traditional ways of presenting it and who are naturally opposed to every innovation of theme or of method. The other extreme is represented by the fadist, the ultra modern, the clamorous reformer whose creed is that whatever is is bad, who confuses the novel with the good, and pursues the new, because it is new, with irrational zeal. Another difficulty is the question of size: how big ought the book to be? The question is puzzling because in our schools there is no uniformity of standard or of practise regarding the amount of time devoted to a given subject. A yet more perplexing question is that of presuppositions: what degree of intellectual maturity and what degree of scientific preparation ought to be presupposed in the pupils for whom the book is designed? Such is our lack of uniformity of standards that an answer that is right for one institution or one locality will be wrong for another, and so the author is obliged to guess and to compromise. Not the least interesting part of the game, and a part that is especially fascinating, because it can never be managed quite successfully, is the part requiring the author to minister at once to the culture interests and the efficiency interests of his readers; for the two interests can not be harmonized nor made identical by the easy device of stoutly denying their difference. Again, the necessity of adjusting the

claims of the theoretician, on the one hand, and the practician, on the other, furnishes the mathematical text-book writer with a perpetually fascinating problem; for the theoretician and the practician have nothing in common save their insistency; in other respects they are as wide apart as the poles; the theoretician is a rigorist, a logician, a lover of the abstract, demands a minimum of assumption and a maximum of proof; the practician hates the abstract, loves the concrete, and mainly depends for his happiness on getting results by the use of rules and formulas that he neither understands nor cares to understand. To win the unqualified approval of both these types of critic is impossible, a contradiction in terms; to incur the unqualified condemnation of both is not impossible; the target to be aimed at is somewhere between; to locate it and to hit it squarely—two very different things—require a rare combination of sanity, skill and good luck.

It may be added that in these times the text-book writer receives additional stimulation from the keen competition of other subjects and from the challenge of certain cunning educators who have shrewdly discovered that the educational value of mathematics has always been greatly overestimated.

The aim of Professors March and Wolff has been to present "the calculus in such a way that it will appeal to the average student rather as a means of studying scientific problems than as a collection of proofs and formulas." The aim is commendable but in saying so we do not intend to imply, and the authors would probably not contend, that the calculus must appear either as such a "means" or as such a "collection" for it has other aspects, aspects both attractive and worthy. Integration is introduced at an early stage. In connection with the employment of infinitesimals, Duhamel's theorem is used but without too much finesse. There are numerous applications to elementary classical problems of geometry, physics and mechanics. A brief introduction to analytical geometry of three dimensions is inserted for such readers as may require it. The phrasing is in general so careful and so good that its very excellence operates as a challenge, and one is tempted to ask whether it would not be a trifle better to say that the phrase, division by zero, is meaningless than to say (p. 30) that "division by zero is an impossible operation"; to say that the fraction, $(x^2-4):(x-2)$, has no value for $x=2$ than to say "its value is not determined at this point"; to say in such a case that there is no quotient than to say that "the quotient has no meaning." The volume closes with a very brief chapter dealing with simple types of differential equations.

To differential equations Professor Love devotes three chapters amounting to more than fifty pages. Integration is not presented earlier than page 116. This is preceded by a chapter on curve tracing. The reader is impressed with the possibility of calculating the most important mass-moments of first and second order by means of simple integration. Applications are drawn exclusively from geometry and mechanics with unusual emphasis on the latter. The importance of checking results, particularly in integration problems, is stressed. An excellent feature is the presence of "worked examples" to assist the reader in making transition from theory to practise. In Professor Love's book as in that of Professors March and Wolff the fundamental theorems respecting limits are set down without proof.

In Mr. Barker's book we have a pretty plain specimen of plane trigonometry. Trigonometric series are not present. Of the wider bearings and higher attachments of the subject the reader is not made aware. Much attention is rightly given to simple applications. The large page and open type please the eye. The punctuation is unusual and not consistent with itself. The radian is defined as if it must be conceived as always having its vertex at the center of a circle. The words "these" and "this" (pp. 2, 3) are assigned to duties that they are unable to perform. In article 4 one is at a loss to determine the significance of the repeated phrase, "said to be." The author has sometimes allowed himself the freedom of such colloquial expressions as "Expand the left members and we have" (p. 86).

Physically, mechanically and stylistically Professor Skinner's College Algebra is a tidy piece of work. It is up-to-date in its inclusions, exclusions and emphases. Its early use of geometric representation is happy. The notion of function occupies a dominant place in the entire perspective. In the definition of this notion (p. 49) the meaning of the term "known" may lead to interesting dialectic, especially if the function be implicit. Five convenient tables are inserted at the end of the volume.

Professor Dowling's "Projective Geometry" is a handsome introduction to the most exquisitely beautiful of mathematical subjects. The treatment, which is in the manner of Reye's classic "Geometrie der Lage," is synthetic as distinguished from algebraic, and presupposes no knowledge beyond ordinary elementary geometry and a very little trigonometry. It does not aim at the rigor of the postulational method, but is preliminary thereto and admirably qualifies the reader to appreciate the nature and the value of that method.

In his "Elliptic Integrals" Professor Hancock has compressed a large amount of matter into a small compass. If the work be too compact for most of those who would like to read it, the fault is not that of the author but rather that of the editors who desired him to write a work which "shall relate almost entirely to the three well-known elliptic integrals, with tables and examples showing practical applications, and which shall fill about one hundred octavo pages." This assigned task has been done faithfully, and the reader will thank the author for his full citation of the literature of the general subject.

C. J. Keyser

Columbia University

SPECIAL ARTICLES

INHERITANCE OF WINTER EGG PRODUCTION

PRELIMINARY REPORT

A. Progeny of a Cornish Male.—A Cornish male was mated *simultaneously* to several (5) Rhode Island Red hens of high fecundity families with a mean winter production of 52.5 eggs and to several Cornish females. The latter are poor winter layers with a mean of 8.47 eggs. There were 33 pullets from the Cornish and Rhode Island Red cross with a mean winter production of 49.2 eggs, the range being 21–86.

The offspring of this male with pure Cornish females were 11 in number and with the exception of a single individual were poor winter layers, the average of all being 11.6 eggs.

The result from the Cornish male and Rhode Island Red female cross is diametrically opposed to that obtained by Pearl from Cornish males (of the same strain that I used) bred to Barred Plymouth Rock females which are good winter layers. The offspring of this cross gave a mean winter production of 16.7 eggs. The reciprocal cross, viz., Barred Rock males and Cornish females, gave an average winter production of 30.7. We have no data at present from the corresponding cross with Rhode Island Reds. It is clear from the results of my experiment that high-producing hens are able to transmit this ability directly to her daughters, that is, high fecundity in Rhode Island Reds is not sex-linked.

B. A Theory of the Inheritance of Winter Egg Production Alternative to Pearl's.—It has been found that the observed ratios in which high and mediocre producers occur, both in Pearl's data on Barred Plymouth Rocks and my own with a large series of Rhode Island Reds, can be explained satisfactorily by assuming that high egg production depends upon two factors that follow the usual dihybrid Mendelian scheme. One factor alone, in either simplex or duplex condition, is assumed to give mediocre production. This theory encounters only one difficulty, viz., in a few instances there is a deficiency in the expected numbers of high producers, a result easily explicable with a physiological character such as egg production. Pearl's theory, however, encounters the reverse difficulty, *i. e.*, high producers appear where none are expected. This difficulty is explained by Pearl on the very reasonable assumption that it is due to an overlapping of phaenotypes.

There is, however, a serious difficulty with the data from both sources. This difficulty lies in the fact that the average number of daughters per mother is extremely small. The average number of daughters per mother in Pearl's experiment was 2.85, while in mine it varies from 2.6 in the early years to 6.75 in later years. Because of the small size of the families it is possible to fit any family into a place in either scheme, since the ratios expected for the various matings differ only slightly from one another. In spite of the doubt raised as to the *mode* of inheritance of winter egg production it is clear that this character is inherited, for high and low fecundity lines are readily established by suitable matings along family lines.

H. D. GOODALE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION D—ENGINEERING

THE first session was held on the morning of Friday, December 28, in Thaw Hall, University of Pittsburgh, Vice-president Dr. Henry S. Drinker in the chair, with an attendance of about thirty. It was announced that the Sectional Committee had recommended for election to the General Committee, for the office of vice-president, Dr. Ira N. Hollis, of Worcester, and for the office of secretary, Dr. Frederic L. Bishop, University of Pittsburgh. The following officers were elected by the Section:

Member of Council—Dr. George F. Swain, of Harvard University and the Massachusetts Institute of Technology.

Member of General Committee—Charles Henry Davis, of Cambridge, Mass.

Member of Sectional Committee—William Bowie, of Washington, D. C.

The program of the session was as follows:

Railroad track, its defects and abuses, and their amelioration: G. H. BARBOUR. *Historical:* The age of the drawn and that of the driven wheel; ancient English tramways; the institution of that distinctively American principle now governing the construction of railroad track as now practised by all the steamroads in the world, wherein the equipment upon its track constitutes a flexible superstructure upon an elastic roadbed. *Defects:* Weak rails; narrow railheads; excessive deflections; joints. *Abuses:* Worn and ragged wheels; improper wheel spacing; dynamic augments; lateral thrusts. *Amelioration:* Increased bearing on ballast; decreased depth of ballast; augmentation of rail; increased lateral strength; broader head; more frequent lateral fastenings; maintaining height of rail at the minimum.

The scientific principles of building codes: J. A. FERGUSON. A good building code occupies a very responsible position among the vital issues of municipal welfare. Properly planned, a building code should insure safety to life, limb, health and property, and should function to minimize loss or injury to either. Progress in the arts has introduced many new factors in the occupation of buildings, which necessitate the scientific handling and classification of the requirements and progress in building has made it possible to classify the various forms of building construction into distinct groups. The same progress has made it possible to classify occupancies and construction of buildings and to specify the minimum allowable construction for the various occupancies. This it is now proposed to do in one notable case for the city of Pittsburgh, Pa. Other phases of this subject are susceptible of scientific definition, and in order to properly regulate buildings it is becoming increasingly necessary to classify and define in a scientific manner all subjects. The paper gives typical arrangement for a code and explains the reasoning upon which it is based as well as for the classification of other regulatory provisions in a good building code.

Relative efficiency of different methods of repairing bituminous macadam and bituminous concrete pavements: GEORGE H. BILES. The bituminous macadam and bituminous concrete pavements in their various stages of disrepair offer excellent opportunity to the highway engineer for study and experiment. The methods of repairs to pavements of these types have advanced to such a degree in recent years that there are innumerable instances where pavements have been reclaimed by scientific analysis of the causes of deterioration and by efficient application of the principles of repair applicable to each case. Central bituminous mixing plants are advisable where the amount of yardage and its accessibility warrant as in cases of municipalities. In most other cases,

general repairs can be made successfully with cold bituminous preparations.

The efficiency of the application of cold bituminous materials for surface treatments on gravel and broken stone roads: Julius Adler. In the development of bituminous surface treatment practise during the past ten years, the most important step forward has been the recognition of the fundamental necessity of a road well built in every respect, and having a mosaic surface especially adapted to receive the bituminous material. In the selection of the latter, a greater and desirable degree of uniformity of practise will follow upon a clear understanding of the characteristics which identify them as most suitable to serve the two functions of: (*a*) Priming; (*b*) smoothing and rendering impervious the road surface. The precise limits of suitability of bituminous-treated roads can hardly be determined definitely in traffic units because of the difference in materials in use, and combined traffic and climatic conditions. From an economical standpoint, they represent a high annual maintenance charge which is an argument in favor of their use in the preservation of existing roads, rather than in a program of new construction. The full possibilities in their use, however, will not be realized until high-grade original construction, scientific selection of materials and systematic maintenance are all combined.

Present status of granite block pavements: C. D. Pollock. This paper describes the improvement of the granite block pavement from its early form to the latest types of smooth surface, close jointed pavements. The latest and best joint fillers are shown and likewise the various cushions or beds for the blocks. The great improvements which have been brought about in making granite blocks and also in laying this pavement, in recent years, are due entirely to the cooperation between the engineers and the quarrymen. The engineers learned enough of quarrying to draw specifications calling for the best practicable block and the quarrymen have exerted themselves to make that block.

Rattler tests for paving brick of various depths: William C. Perkins. Discussion of the rattler used for testing paving brick and a short history of same. The testing of paving brick of different depth and the theoretical determination of an allowance or differential for same. Discussion of a modification of the abrasive charge in rattler in the testing of paving brick.

Motor trucks and long distance highway transportation: Maurice B. Greenough. Statistics show that the railroads have nearly if not quite reached the limit of their capacity for freight hauling. At the same time there is a growing shortage of cars. They themselves have advocated the use of motor trucks on the public highways for short hauls to relieve congestion. Increased highway construction and organized effort to encourage the use of highways are essential to make the potential relief an actuality.

The construction and maintenance of highways under war conditions: Arthur H. Blanchard. Since the United States entered the war, motor truck transportation on country highways has rapidly developed due to the following causes: First, the marked increase in the tonnage and bulk of shipments; second, the lack of railroad equipment to efficiently handle freight and express transportation; third, the inadequacy of railroad terminal facilities; fourth, the United States government priority orders; and fifth, the intensified consideration of economic problems, the solution of which would lower prices of the necessities of life. Suggestions relative to construction and maintenance of highways under war conditions: (1) Maximum use of motor truck transportation of materials and machinery; (2) amendment of onerous traffic regulations which prevent economic use of motor trucks; (3) modification of state laws to permit construction and maintenance of highways by day labor; (4) award of contracts to responsible contractors on a cost plus a profit on labor and rental of equipment, all materials being furnished by the state or county; (5) modification of contracts and specifications which place all liabilities on contractors; (6) maximum use of labor-saving machinery; (7) maximum utilization of convicts and prisoners of war; (8) construction and maintenance of military highways by the United States government.

The second session was held on the afternoon of December 28 in the Lecture Hall of the Mellon Institute, Vice-president Dr. Henry S. Drinker in the chair, with an attendance of about one hundred ten. This meeting was a joint session with Section C; Society for the Promotion of Engineering Education; Engineer's Society of Western Pennsylvania; Pittsburgh Section, American Electro-Chemical Society, and the Pittsburgh Section, American Chemical Society. The program of the session was as follows:

Vice-presidential address, some needs of engineering: Dr. Henry M. Howe. Printed in the issue of Science for January 25.

Mechanical manufacture of window glass: DR. F. L. BISHOP.

A manufacturer's experience with graduate chemical engineers: S. R. CHURCH. Two years' experience with about one hundred graduate chemical engineers has suggested the following apparent deficiencies in training seemingly common to men from a large number of colleges:

1. Lack of judgment necessary to weigh correctly
   (*a*) the value or limitations of test data;
   (*b*) the degree of accuracy required;
   (*c*) the occasion for choosing quantitative or qualitative methods of analysis.
2. Lack of sufficient imagination to grasp the indicated possibilities for further work pointed out by experiments themselves partial or complete failures.
3. Lack of ability to write a report sufficiently well ordered and comprehensive to do justice to the merits of the work accomplished.

The writer favors the five- or six-year course for chemical engineers but urges that especially in abbreviated courses the student be given a better practical sense of commercial values.

A survey of high-school chemistry in Pennsylvania: ALEXANDER SILVERMAN. The report includes graphs and tabulated answers on college preparatory chemistry from 126 of 971 schools receiving information blanks. Answers cover length of course, when given, whether preceded or followed by physics, number of lecture periods per week, recitation periods, length and number of laboratory periods, number of sections of each and number of pupils per section, text-books employed, laboratory manuals employed, elements omitted, theories, laws and principles omitted. Also information about general science and other chemistry courses given, number of subjects taught by instructors together with number of hours of lecture, recitation and laboratory practise conducted. Further, the training received in preparation for teaching. The great lack of uniformity already observed leads the author to recommend standardization by a state commission, or preferably by the United States Commissioner of Education, with power to enforce standards so that colleges and universities may begin their work where the high schools end, thus avoiding duplication.

The following resolution was unanimously adopted:

Resolved, That the thanks of the Joint Conference be extended to the *New York World*, the *New York Times* and the *Jeweler's Circular* for cooperating with the chemists of the United States in the conservation of platinum by excluding the word platinum from their advertising columns.

The third session was held on the morning of Saturday, December 29, in the Applied Science Building of the Carnegie Institute of Technology, Vice-president Dr. Henry S. Drinker in the chair, with an attendance of about forty-five. The program of the session was as follows:

Solution of spherical triangles by diagrams: HORACE R. THAYER. All spherical triangles may be solved by the use of two simple formulæ. If now these be accurately computed and plotted, they may be employed to solve many cases which occur in practise with a minimum of cost, at the same time lessening the danger of serious error.

Conservation of fuel through smoke regulation: J. W. HENDERSON. Conservation that merely contemplates withholding the natural resources from use, keeping them in their natural state, can hardly be considered conservation in its broadest application. The logical starting point is that of "taking stock" of the natural resources. Having this knowledge, conservation can be carried on, on the basis of "the application of common sense to common problems for the common good." The needless waste of fuel and of recoverable by-products, in this country, has been conservatively estimated at one billion ($1,000,000,000) dollars annually. Investigations and experience demonstrate that the production and emission from stacks, of smoke prohibited by law, means *waste*—direct waste of combustible materials and their by-products and contributory, contingent waste of building materials, household goods, vegetation and of human energy, both physical and mental. In a few cases smoke regulation is under state control. Many foreign countries have placed it within the activities of their central governing powers. The work in Pittsburgh has proved that smoke regulation is a fuel conservation problem. Smoke means waste. Proper smoke regulation results in saving fuels. Conservation as proposed will induce complete combustion of them and stop the production of smoke. Smoke regulation is so closely related to conservation as to indicate the necessity of the government adopting it in its program of conservation. The work can not be of a constructive and permanent character if left to the fluctuating political activities of the cities, counties or states. The way to meet the requirements is to not make the smoke. This is accomplished by securing more perfect combustion. The subject deserves the attention of scientists and of practical engineers and of every thinking man and woman

who appreciates that there is an "inalienable right to life, liberty and the pursuit of happiness." Smoke regulation of the character indicated should be country-wide.

Modern tendency in locomotive design: L. E. Endsley. The locomotive of to-day is being scientifically designed and constructed in order to produce as efficient and powerful a locomotive as possible with the minimum of weight. Special grades of steel are used and some parts are being heat-treated in order to get a stronger part of less weight. To-day a horsepower is being developed in the modern locomotive with thirty per cent. less coal than that fifteen years ago. This has all been brought about by the addition of superheaters, brick arch, stoker, etc.

Measuring telephone transmission: R. L. Snyder. Brief review of the advance made in the art of measuring transmission over telephone lines. Notation of the characteristics of circuits which cause losses in telephone transmission. Pointing out that savings are accomplished by the advance in the art of calculating and measuring telephone transmission.

Industrial housing and town planning: George W. Case. Many of the industrial towns being built in America are laid out according to the Garden City idea, a method of city planning which originated in England. A Garden City plan is one in which sufficient ground is devoted to each house to provide, in addition to plenty of light and air, a garden for every family. The streets are generally laid out to curve with the contours, to reduce the amount of grading and allow the placing of houses to obtain the best architectural effects. Parks and playgrounds provide places for recreation and proper restrictions insure permanent homes. Under an enabling act of 1890 the British government lends money on long-term bonds, to be used in building houses for working people, on tracts laid out in the above manner. We need such a law, in this country, to properly develop the boundaries of our industrial cities, so they will not become slum areas and also to build permanent houses for our working people, in well-laid-out tracts, and finance them so that the payments can be made to fit the income of the wage-earner. The high labor turn-over, being experienced in our industries at the present time, is receiving much attention from employers, and those who are building houses, of the right sort, report substantial successes in stabilizing their labor forces by this means.

The electrical safety work of the Bureau of Standards: M. G. Lloyd. A study of the accident hazards connected with electrical work led the Bureau of Standards to formulate a set of rules for the construction and operation of electrical equipment which is known as the National Electrical Safety Code. These rules were published over a year ago after many tentative drafts had been criticized and revised by conferees representing the various utilities, inspection interests and state commissions interested in and affected by the rules. The Code has been cordially received and is receiving general application on trial with tentative and in some cases formal adoption by federal, state, municipal authorities and private bodies.

Higher harmonics of polyphase electrical systems: V. Karapetoff. Higher harmonics in a symmetrical m-phase system are considered for both the star and the mesh connection. It is shown which harmonics can not exist in the mesh voltage although present in the star voltages, and which harmonics give rise to circulating currents in a mesh. The phenomenon of oscillating neutral is explained and the effect of secondary mesh currents in furnishing transformer magnetizing currents is discussed. Polyphase magnetomotive forces are treated in the most general case when harmonics are present both in time and in space. Formulæ are given for the order of harmonics which produce gliding and pulsating M.M.F.'s.

Mineral composition of refractory silica brick: J. S. McDowell. Of the minerals tridymite, cristobalite and quartz constituting silica brick, tridymite has the lowest thermal expansion. An all-tridymite brick would, therefore, have the lowest spalling tendency. Microscopic analyses of brick burned from one to ten times show that at the slow rate of inversion of the quartz to tridymite, an all-tridymite brick would not be commercially practical. Analyses of two bricks, one made of Baraboo and the other of Medina quartzite, illustrate the greater rapidity of the inversions of quartz to cristobalite and tridymite with the finer textured Medina rock.

Why dams fail: Edward Godfrey. History of under pressure as an idea in the professional mind. Present status of the idea of under pressure. Loss of weight of dams and submerged piers discussed and compared. Tests of under pressure. Explanations of the failure of dams. The kind of masonry dams that fail. Inefficiency of some attempts at prevention of failure by uplift.

Arthur H. Blanchard,
Secretary

SCIENCE

FRIDAY, JUNE 7, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

UNIVERSITY IDEALS AND THEIR LIMITATIONS[1]

WHEN I was asked to address the "Forum," it was with a thrill of pleasure that I accepted, for I felt that this invitation would give me the opportunity of addressing the soul of the student body, for this student body has a youthful, forceful soul, where a clearly conceived and beautiful idealism aspires to adequate self-expression.

It may seem unnatural to some of you that I should find it possible to speak today upon a topic which has no *special* relation to the great war. In so doing, however, I have merely followed the example of Professor George Sarton, who so recently delighted and instructed us in his lectures on "The New Humanism," and my special reason for imitating this distinguished Belgian is that, whatever may be our part in the great struggle now in progress, our outlook on this or any other crisis must of necessity be from the point of view of university men, men whose acts are directed and whose thoughts are inspired by university ideals. It is therefore as imperative at this time as at any other to enquire into the natue of these university ideals, which have been our heritage from the past and form our background in the present and whose influence is none the less profound in that we are generally quite unconscious of its operation.

The terms "university" and "state university" are quite distinct. The institutions so named may have very little in

1 Address delivered before "The Wisconsin Forum," January 20, 1918, at the University of Wisconsin.

common. A university is a postgraduate school devoted to the pursuit of truth regardless of its material usefulness. A state university may be only a college, by which I mean a sort of advanced high school. Thus the word "university" designates a distinct entity; while "state university" is a title of dignity.

Wherever there is a university there is also a tendency for the formation of other educational units, a college, professional schools, technical schools and art schools, and the name "university" tends to be stretched to cover all these. Whatever may be the original character of a state university, it tends to develop a postgraduate school after the model of the university and ultimately to comprise, in addition to this postgraduate school, a college, professional, technical and art schools. The formation of these large educational aggregates is a feature of the times. They are the results of economy and convenience.

Naturally the close association of several component institutions causes great modification in all of them through mutual interaction, so that we might expect to find the postgraduate school of a state university, like the University of Wisconsin for example, somewhat different from, let us say, the Johns Hopkins University in the eighties or Clark University at the present time. The degree and character of the development of the various constituent organizations which go to form such an educational aggregate as above referred to will depend largely upon the special causes which have brought the institution as a whole into being and those by which it is maintained.

From the foregoing and from the title of this address, "University Ideals," it might be expected that this discussion would concern itself with the ideals of an isolated post-graduate school. Strictly speaking this is not the case. For practical reasons, which I need not stop to enumerate, I shall discuss an institution where in addition to the work of the university proper, undergraduate teaching is carried on to at least a small extent.

It may be remarked, however, that although I speak specifically of science and the scientific, I *believe* that, *mutatis mutandis*, for example the substitution of the word "creation" for the word "discovery," the statements which I am about to make would apply to any component art or literary institution.

The ideals of a university concern its activity and its attitude. The former, as already stated, is the *pursuit of truth* regardless of its material usefulness and in so far as the college is concerned with the exposition of this truth to the undergraduates. The ideal attitude of the university is characterized by its being *agnostic* (a term which will be carefully defined later) and also what I shall designate for want of a better word *universal*. To a consideration of these we shall now turn our attention beginning with a discussion of the search for truth.

Guizot once said:

> Science has its sublime speculators who are, so to speak, its prophets who detect instantly the great laws of the universe and grasp them, as Columbus discovered the New World, hastening to the search in the faith of an idea. Around them are drawn up the sagacious observers who excel in searching out, establishing particular truths, describing them and uniting them successively to the domain of science. And into this domain so enriched enter the legislative minds who classify the facts received, note their relations and determine their laws, and transform them into those general formulas which define the present state of science and become the points of departure and the instrument of future conquests.[2]

[2]Quoted by E.-F. Dubois, "Eloges lus dans les séances publiques de l'Academie de Médecine," II., p. 116.

Such is the activity of a university, always bearing in mind the fact that the "sublime speculators" are few and far between and that most of us while following the path laid down by them and enjoying the fruits of their genius must content ourselves with the study of lesser problems. To devote ourselves to such activity and then to return from time to time from expeditions into the unknown with our sack full of treasures which our enthusiasm loves to show to eager and inquiring students whose highest ambition is to follow us and to wrest from Nature the secrets which she in playful reluctance yields to us, is one of the keenest joys the intellect can experience.

But this very simile of an expedition carries with it this question, who is to pay for the expedition? Who is to fit out the ships of Columbus? Who is to endow our laboratories and our professional chairs? It is indeed an important fact that every researcher is dependent either directly or indirectly upon the bounty of some person or persons who may be called the patrons of learning and who, whether they be the people of the state or some smaller group, are always on the watch for what they deem adequate returns. It is only in heaven, where the pangs of hunger can not reach us, that there can exist such a condition as is described in the stanzas,

> No one shall work for money, and no one shall work for fame;
> But each for the joy of the working, and each in his separate star,
> Shall draw the Thing as he sees It, for the God of Things as They Are![3]

For all our pursuings of truth must sooner or later be endorsed by the patrons at whose expense we dine or at least lunch. Thus the range of activity of the university is limited not only by the intellectual shortcomings of the researchers themselves but by the attitude of the patrons. These persons, being only human, may be affected unfavorably, and therefore in the direction of limitation, by two factors, namely, their incapacities and their prejudices.

Of these the second, namely the prejudices, are the more potent if less conspicuous, and are also singularly resistant toward external, ameliorative influences. The mode of action of these prejudices is very familiar to us all. All are aware that no researcher whose results are offensive to the patrons can retain their support, for

> This same truth is a naked and open daylight, that doth not show the masks and mummeries and triumphs of the world half so stately and daintily as candlelights.[4]

We have but little reason to hope that this form of limitation may be relaxed through changes in the political order. We are too prone to believe and to assert that in a *real* democracy research of every sort will be encouraged and all truth will be welcome. This naïve over-confidence in democratic institutions is rudely shaken when we recollect that it was in the most intellectual and cultivated democracy that the world has ever known that Socrates was tried and convicted, "firstly of denying the gods recognized by the state and introducing new divinities, and secondly of corrupting the youths of Athens." Thus, although Athenian democratic society was eminently fitted to develop intellectual brilliancy, it was hostile to intellectual liberty and when brought into opposition to the dominant prejudice and dominant public opinion, the way of the innovator was hard.

There are few who would expect that a consideration of post-Athenian ways and customs would lead to encouraging comparisons.

[3] Rudyard Kipling, "L'Envoi" of "Seven Seas."

[4] Francis Bacon, "Essay on Truth."

Although the stigma of intolerance may cling to mankind forever there is a second factor which also limits intellectual freedom but which is capable of very great amelioration. This is the failure on the part of the patrons to appreciate the choicest fruits of scholarship and research.

It is more rare that a failure of appreciation leads to dismissal of a professor, but it is a matter of not unusual occurrence that persons whose vision is not easily followed are thwarted, nagged and otherwise actively encouraged to go somewhere else where the patrons are more enlightened.

As an example of this nagging which is none the less disagreeable for being unpremediated, I can not refrain from quoting a story, as realistic as it is imaginary. It is told by President Maclaurin, of the Massachusetts Institute of Technology, in his article on "Efficiency and Education":

> The superintendent of buildings and grounds, or other competent authority, calls upon Mr. Newton. *Superintendent:* Your theory of gravitation is hanging fire unduly. The director insists upon a finished report, filed in his office by 9 A.M. Monday next; summarized on one page; typewritten and the main points underlined. Also a careful estimate of the cost of the research per student hour.
>
> *Newton:* But there is one difficulty which has been puzzling me for fourteen years and I am not quite . . .
>
> *Superintendent* (with snap and vigor): Guess you had better overcome that difficulty by Monday morning or quit.[5]

If, however, an investigator insists on continuing upon his way through fields of investigation which make no obvious appeal to the patrons unless it be to arouse their spirit of economy, then two courses are open to him. He must either accept a situation which acknowledges that poverty is the patrimony of the Muses or he must find some method of winning the approval of the patrons for his cherished line of research.

In connection with the first of these alternatives, I recall with the greatest pleasure a certain penniless scholar whom I know and greatly admire but whose example I will not recommend for the reason that his mode of life is too ascetic and his privations too severe. Indeed I feel with Burton, that delightful old chatterbox, when he asks in his "Anatomy of Melancholy,"

> What Christian will be so irreligious, as to bring up his son in that course of life [that of the poor scholar] which a beggar's brat taken from the bridge where he sits a-begging, if he knew the inconvenience, had cause to refuse it![6]

If on the other hand the investigator rejects the undowered Muse as a proposition not only personally inconvenient but also incompatible with his own highest efficiency, he must find some way of winning the approval of the patrons. It is here that the privately endowed universities may have some advantage over those which rely on popular support. For in the former pure science may be cherished not only because its more cultured patrons are more appreciative of æsthetic and spiritual values but also because of the affection which their class (the wealthy and leisure class) has for activities, which, because of their apparent uselessness, contribute the more to their social prestige. Such non-material returns are not likely to appeal at once to the patrons of a state university, that is, to the common man, still less to the "hard-headed" (that is, unimaginative) business men who sometimes dominate a board of

[5] R. C. Maclaurin, "Education and Industrial Efficiency," SCIENCE, XXXIII., p. 101, 1911. This story I once had the mischievous pleasure of sending to Mr. Allen, of the Wisconsin University Survey, and was complimented by having him write me requesting the exact reference!

[6] Robert Burton, "The Anatomy of Melancholy," Pt. I., Sec. 2, Mem. 3, Subs. 15, 1652.

regents, so that to some vigorous procedure resort must be made.

Offering themselves for our trial or consideration are two such procedures, namely the method of exaggeration and the method of education.

The first of these consists in an effort to make the patron, who in the case of the state university is the common man, feel that the pursuit of pure science will soon and in some way contribute to his physical well-being. Science, it is said, must be cultivated because of its useful application, and so, under the ægis of a useful application of some science or other, the rest of the pure sciences hurry to place themselves, like the acquaintances of a man with an umbrella. The method of exaggeration is in all instances unfair and in the case of the state universities undemocratic. It assumes that the attainment of truth by ourselves is of more importance than its appreciation by the patrons, an assumption which is especially pernicious in the state universities, where the patron is the common man, the people of the state. The method tends to create an intellectual aristocracy on the one hand and a suspicious commonalty on the other. It is a hard saying that those who believe they are investigating purely for "the glory of God and the benefit of man's estate" are often damaging society. But they are when they give to others the material benefits of their labors and keep to themselves the glory of God which has been revealed to them.

But even when we emphatically reject the method of exaggeration and seek to create a real appreciation of the higher values for which the university stands, if, in other words, we set about employing the method of education, even then through force of habit we are very prone to emphasize the lesser and more obvious at the expense of values which, though actually far greater, we consider to be less obtrusive.

As an example in this connection I recall a plea which I once encountered for the study of Latin. The plea consisted in showing the vast numbers of English words having Latin origins. From these data the thoughtless observer was expected to infer a great practical advantage in learning Latin! The common man is quite susceptible to a better and truer argument. He is quite ready to admit the value to the Chinese of a familiarity with our culture; it is not difficult to persuade him that he too might derive much benefit from a knowledge of the culture of the Chinese; it is but a small step from a people living to-day to a people who lived long ago, but who possessed a remarkable culture; and having gone so far, is the common man likely to balk when he finds that the language should not be separated from the literature, the art and institutions of this interesting and instructive people? The common man will admit the advantage of seeing himself as others see him, of viewing our own times and institutions as one freshly arrived from Mars. But such an advantage is possible only to those who have acquired a second culture, that of another race or of another time, in the light of which our times can be less naïvely regarded.

Be it reiterated, then, that we intellectual aristocrats are only too prone to lower our tone to the supposed level of the common man. We should rather encourage him to demand that what he does not understand be made at least partly intelligible to him and we should ever stand ready to disclose our real motives and to share with him our real joys.

In the informal and personal application of this method of education of the common man, the patron of the state university,

we must rely upon the endeavors of those who are in touch not only with the common man but also with the university, who from their origin can sympathize with the one, while by their training they can appreciate the other. I refer to our college graduates. Let these men and women go forth and teach that the benefits which science confers are not only of a material but also of a spiritual character, and that it only remains for the common man to claim the enjoyment of the second as he has already appropriated the first to his use; furthermore that although these benefits are the sole claim which the investigator has upon the patronage of the common man, still these benefits will suffer if made the sole object of impatient search.

It should also be made clear that in many cases, I can not say how many, the value of research is not only measured by what it contributes to science but by what it contributes to the investigator. The theses which our undergraduate students write are in many cases wholly untrustworthy. He must repeat their work step by step before the careful contributor dare present it to a scientific periodical and yet who can doubt the effectiveness of thesis writing as an educational exercise. It is the same with members of a faculty. It is a hard saying, but I believe it is true, that many of our productions achieved with care and accuracy are too insignificant to justify the time expended on them were we to exclude their benefits to the investigator. The patrons need not feel obliged to support such research unless it be performed by one who is at the same time a teacher. In the latter case his researches may be regarded as a most important preparation for his daily task of instructing others. It is only when one devotes his entire time to research that the intrinsic value of those researches demands the serious attention of those concerned with economical administration.

Unfortunately for the spread of our gospel of culture there is a large element in our population which is not likely to be touched by any of our appeals. People who have not enough to eat or to wear, who have been made stupid or angry through economic pressure, do not wax enthusiastic over the rings of Saturn, the origin of the heart beat or the structure of snow crystals. Before this class can become sympathetic with the search for truth regardless of its material usefulness, there must be a considerable modification in the economic structure of society. For such a modification the extension of our ideals in this direction must wait. If it be deprecatingly asked if this is not a subtle endorsement of the doctrine of economic determinism, it may be replied that it means nothing more nor less than the similar affirmation that "Food will win the War."

Having discussed at some length the pursuit of truth and the limitations which are imposed upon it, let us turn from the activity of the university to the second category in which its ideals are manifested, that is, as stated in the beginning of this address, to the ideal attitude. The university attitude is characterized by being critical or rather agnostic and universal, and these we shall discuss in turn.

The terms agnostic and agnosticism have been used in so many ways that many persons have entirely lost sight of their real and original meanings. The word "agnosticism" has been used in theology to designate the inability of finite man to comprehend an infinite God; it has been used in philosophy to describe the impossibility of the mind to know reality, the "Ding an Sich"; it has been used by popular controversialists as a synonym of infidelity. I

now use it in its original sense, the sense given it by the scientist who first coined the term, and if it be necessary to add to it a distinctive adjective to rid it of any ambiguity or invidious implications, it might be called "scientific agnosticism." It is this attribute of scientific agnosticism which is the characteristic of the ideal university attitude.

The agnostic attitude is doubtless as old as human intelligence. This it is which prompts us to cry like Othello

> . . . Give me ocular proof
> Make me to see 't; or, at least so prove it
> That the probation bear no hinge nor loop
> To hang a doubt on.[7]

Alas that Othello should have been so easily satisfied! It is, however, to men of the generation of Tyndall and Huxley that we owe most for the popular exposition of this attitude. The latter, who, by the way, first coined the word "agnostic," points out that this attitude consists in the acceptance of a principle which is as much ethical as intellectual, that it is wrong to affirm as certain that for which we can not produce evidence which may logically justify that certainty. He then continues:

> The results of the working out of this principle will vary according to individual knowledge and capacity, and according to the general condition of science. That which is unproven to-day may be proven by the help of new discoveries to-morrow. The only negative fixed points will be those negations which flow from the demonstrable limitations of our own faculties. And the only obligation accepted is to have the mind always open to conviction.[8]

From this we see that what has been called the agnostic attitude is really a combination of skepticism and openmindedness.

An example will press home this conception more than any number of generalizations and I shall consequently quote from the life of Pasteur an incident which is charmingly illustrative.

When Pasteur claimed to have discovered that the salts of racemic acid consisted of two kinds of crystals, one kind right-handed and turning the plane of polarized light to the right, the other left-handed and turning the plane of polarized light to the left, a discovery of extraordinary importance, the veteran chemist Biot, then seventy-four years old, showed some skepticism. Holding his head on one side, speaking very slowly and smiling ironically Biot kept saying to the friend of Pasteur who had communicated these results to him, "Are you quite sure?" "I should like to investigate this young man's results."

Hearing this, Pasteur arranged an interview with Biot at the Collège de France, where the latter resided. There Biot produced a specimen of racemic acid which he himself had proved to have no effect on polarized light. Then under the direction of Pasteur he proceeded to prepare the solution from which the crystals might be obtained. This done, Pasteur was sent away. When the crystals had been deposited from the mother liquor, Pasteur was sent for to demonstrate to Biot the two sorts of crystals. After he had done so Biot said: "So you affirm that your right-handed crystals will deviate the plane of polarized light to the right, and your left-handed ones will deviate it to the left?" "Yes," said Pasteur. "Well, let me do the rest," and Biot was again left to dissolve the two sorts of crystals separately. Soon after this in Pasteur's presence Biot convinced himself that the assertions of the former were correct. Then taking Pasteur by the arm he said: "My dear boy, I have loved Science so much during my life, that this touches my very heart."[9]

[7] Shakespeare, "Othello," Act III., Sc. III.

[8] Thomas H. Huxley, "Collected Essays," V., pp. 245–246, 1897.

[9] René Vallery-Radot, "Life of Pasteur," pp. 40–41, 1906.

There are times, however, when we find that skepticism is not combined with openmindedness. Many a great advance in science has been greeted with a storm of ridicule or abuse by skeptics with closed minds. Of Van't Hoff they cried: "See this young man fly his Pegasus borrowed, no doubt, from the stalls of the veterinary college where he is a professor!" So it was with Semmelweis and Oliver Wendell Holmes, the discoverers of the infectious nature of child-bed fever, and so also with Darwin and a host of others.

"We used to debate the Darwinian Hypothesis privately," writes Professor Shaler of the time when he was a pupil of Agassiz, "for to be caught at it was as it is for the faithful to be detected in a careful study of a heresy. We had both read the 'Vestiges of the Natural History of Creation,' Lamarck's 'Philosophie Zoologique,' and first the Darwin-Wallace papers and then the newly published 'Origin of Species.' Agassiz had given a large part of his lectures in one term to denouncing these works and to the assertion that species were absolute creations. He never even suggested how the special creation came about, and when, at the end of a lecture, I pressed him for some conception of how a species first appeared, he stated that it was a 'thought of God!' "[10] An answer which, though it may be true philosophically, is biologically speaking quite irrelevant!

This fact, that skepticism is so often divorced from openmindedness, limits greatly the influence of the university upon the common man. The common man has discovered in the universities not only the agnostic attitude but also this counterfeit which he improperly calls "conservatism." This is an unfortunate use of a good word and leads us into endless ambiguities. "Conservatism" is the sentiment which seeks to preserve all that is truest and best both in the present and in antiquity. When on mature consideration we have decided what is best, it is conservatism which directs us reverently to cherish it. But the counterfeit which the common man has detected is the mind which, though skeptical, is tightly closed, it is the mind that believes that that which is, is best and, in refusing to sanction any novelty, claims to be exhibiting the agnostic attitude. This attitude, when it is not actually assumed for selfish motives, is an indication of precocious mental senility, of mental inflexibility or calcification. Its presence is always obstructive; its appearance is always ugly. It may lead a thoughtful nature to such outbreaks of exasperation as we find in the play of Faust:

By that I know the learned lord you are!
What you don't touch, is lying leagues afar;
What you don't grasp is wholely lost to you;
What you don't reckon think you can't be true;
What you don't weigh, it has no weight, alas!
What you don't coin, you're sure it will not pass.[11]

It is a great misfortune that there is as yet no adequate way for the common man to distinguish the genuine agnostic attitude from this counterfeit, for it is owing to the discovery that such a counterfeit exists that the universities have been viewed for years with suspicion by many thoughtful members of society, especially of the intelligent working class. For in the case of the academician or scientific expert, what common man can distinguish wise caution from dull or self-seeking immobility!

But the old are unable to grasp a new idea; are they then to be condemned to euthanasia by chloroform at sixty years, as has been playfully suggested? By no

[10] Nathaniel S. Shaler, "Autobiography," p. 128. 1909.

[11] Goethe, "Faust," Pt. II., Act I., Sc. II., Bayard Taylor's translation.

means. Symmetrical old age is beautiful, not ugly. For along with slowness to grasp new ideas, there is increase in toleration and in benevolence. The growth of the mind has given place to growth of the heart and so "the best is yet to be." It is asymmetrical old age which is ugly. It is mental rigidity without spiritual growth which, like old-sightedness in the young, is so much to be regretted.

The scientific attitude is not only agnostic but also universal. To the scientific mind there are no isolated facts or discrete phenomena, but all are integral parts of the great structure of knowledge. To him the separate sciences and subsciences become of importance and significance only as he sees them as elements of more comprehensive units, which in turn make up the ultimate unit which he calls Nature, Weltanschauung or world picture.

In his "Nature of Truth" Joachim shows how such bald statements as "Cæsar crossed the Rubicon," "This tree is green," or "A whale is a mammal," represent not only a minimal degree of truth but possess no importance nor significance whatsoever. To be fully cognizant of the meaning contained in these statements, one should view each in its proper "setting." But what is to limit the indefinite expansion of this setting? Nothing. And it is a fact which need only be expressed to be grasped that none of these apparently simple statements can be *completely* comprehended except by a mind which is omniscient.[12]

Or again if I say "This is a lead pencil" the meaning of my remark will depend upon the mind to which it is addressed. To the child the remark will have relatively a small content; to the learned the connotation of the word "lead pencil" will be extraordinarily extensive. The pencil has a chemistry and physics, even an astronomy. It has a manufacture and a manufacturer with his anatomy, physiology and sociology. Nay more, it may be found to form an integral part of art and ethics and religion! We are all accustomed to being told that the world of to-day can not be understood without its historical background, but the conception just presented leads one step further and we may add no fact is *completely* intelligible or significant except when seen against the background of universal knowledge.[13]

This, then, is what is meant by the term "universality" and we ask what limitations are there to this attribute of the scholarly mind? Promptly comes the answer that to demand of the scientist that he should view every fact of nature in the light of omniscience is absurd. Doubtless this is true, but that his thinking should bear some traces of this universality is not too much to expect. His strict attention is naturally di-

12 Harold H. Joachim, "Nature of Truth," on degree of truth in Chap. III., 1906.

13 It is most interesting to note in passing how closely this conception of the universal element of the scientific mind parallels Schleiermacher's conception of religious feeling. The religious feeling, says Schleiermacher (Friederich Schleiermacher, "Reden über die Religion," 1799; trans. of John Oman, 1893, entitled "On Religion, Speeches to its Cultural Despisers," 1893) may arise from the contemplation of the universe or of any part of it, of all that lives and moves, all growth and change, all doing and suffering. This then is the immediate cause of the religious feeling, but what is the character of this feeling? It is a "sense of the whole." When he looks at a finite object the religious man sees it not in its discrete individuality but always as a "fragment of the whole." The soul and life of the individual is felt by the religious man to be of significance only because it is a part of the universal soul or life which he calls God. With Schleiermacher the feeling is religion and the whole is God. With the scientist there is an imperfect acquaintance with a whole which is nature. To each the feeling of fragmentariness is an accompaniment of finite impressions.

rected to a particular group of phenomena peculiar to the science of his choice. This group lies in the field of his direct vision, so to speak, but surrounding this lies the field of indirect vision, the field of universal knowledge, where objects are less distinctly seen. Between these two fields there is, as already stated, no logical boundary. To be sure our ideas of universal knowledge must be imperfect and vague for any achievement of universality can be but partial. Yet although we may not possess the mind "which is a mirror or glass, capable of the image of the universal world, and joyful to receive the impressions thereof as the eye joyeth to receive light,"[14] yet some effort so to do must be made as our response to this ideal of universality.

Besides this finiteness of man which limits our universality there is another limitation which when it exists is fortunately more amenable to amelioration. It is a certain reluctance to reflect broadly. We live in an age of enforced and minute specialization. Each one of us is anxious to shine in his chosen sphere but also correspondingly reluctant to appear as a dilettante in any other field. We feel, however much we may regret it, that we have no time for mere culture. Ultimately we may even become like coal miners devoting their lives to sending their laden trucks up to the surface of a world they know not of.

This is of course contrary to what I conceive to be the university ideal, and furthermore it is pedagogically undesirable. For I do not think that it can be denied that students would suffer from contact with men who are wilfully limited in horizon. I say "wilfully" because, to the student, contact with aspiration may be as inspiring as contact with achievement. In an atmosphere of limitation the student becomes a specialist also, not in one field but in several. He may study Latin and sociology and music and physiology and become at least for a time a miniature specialist in each, for between these subjects there are to the student's mind no obvious connection. They form no part of a universal scheme of things. Called on to construct such a scheme he would be as helpless as the ancient geographers who

> in Afric maps
> With savage pictures filled their gaps,
> And o'er unhabitable downs
> Place elephants for want of towns.[15]

At length he is permitted to depart from our institutions of learning, taking with him his compartmental knowledge, the more compartmental the more closely he has devoted himself to his studies, whether prescribed or chosen.

How fond we all are of the quotation that Sophocles "saw life steadily and saw it whole."[16] Our veneration of Sophocles rests upon the fact that from necessarily limited data he made a great synthesis, a great induction, and the example of Sophocles commends itself to us as appropriate to set before aspiring young men. But it may be (and that chiefly through our own fault) that few of our students have ever learned that any synthesis, however crude, is possible, much less that it is expected of them. Should not the student take with him from his alma mater the vision of such a synthesis not as a finite act to be performed but as a process continuing all through his intellectual life and evolving as it goes his picture of truth as he sees it?

Percy M. Dawson
University of Wisconsin

[14] Francis Bacon, "Advancement of Learning," Bk. 1, pgf. 6.

[16] Matthew Arnold, "Sonnet to a Friend."

[15] Jonathan Swift, "On Poetry, a Rapsody," pgf. 10, 1733.

SCIENTIFIC EVENTS

NEW EASTERN NATIONAL FORESTS

PRESIDENT WILSON has issued a proclamation establishing three new national forests in the East—the White Mountain, in Maine and New Hampshire, the Shenandoah, in Virginia and West Virginia, and the Natural Bridge, in Virginia.

Proclaiming the forests is the final step in carrying out the law for building up eastern national forests through the purchase of lands in the mountains. Ever since the law was passed in 1911 the government has been engaged in acquiring lands about the headwaters of the principal rivers, both in New England and in the southern Appalachians. As the lands are bought or contracted for, they are put under administration as "Purchase Areas" pending the time when their accumulation has reached a point justifying the proclamation which gives the lands their final status. The Pisgah National Forest, in North Carolina, and the Alabama National Forest, in Alabama, are the only eastern areas which had received this status before the new proclamations were issued.

The White Mountain National Forest is located in Grafton, Carroll and Coos counties, N. H., and Oxford county, Me. The government has actually taken title to about 267,000 acres and in addition about 124,000 acres more have been approved for purchase, making a total of about 391,000 acres under federal protection. This forest protects in part the watersheds of the Androscoggin, Saco, Connecticut and Ammonoosuc rivers. The White Mountain region has great value not only for the protection of streamflow and the production of timber but also as a public playground.

The Shenandoah National Forest is situated in Rockingham, Augusta, Bath and Highland counties, Va., and Pendleton county, W. Va. The government has acquired to date slightly in excess of 100,000 acres, and an additional area of approximately 65,000 acres has been approved for purchase, making a total of approximately 165,000 acres under federal protection. The forest is for the most part on the watershed of the Shenandoah River and it also protects a portion of the watersheds of the Potomac and the James.

The Natural Bridge National Forest is situated in Rockingham, Nelson, Amherst, Botetourt and Bedford counties, Va. The federal government has actually acquired title to a little over 73,000 acres, and an additional area of approximately 29,000 acres has been approved for purchase. The forest, which protects a portion of the watershed of the James River, does not include the Natural Bridge, but this scenic feature is within three or four miles of the boundary.

ALASKA FISHERY AND FUR PRODUCTS IN 1917

The Fisheries Service Bulletin states that although final figures showing the value of the fishery products of Alaska in 1917 are not yet obtainable, the statistics are practically complete so that a reasonably accurate statement of production can now be made. Compilations indicate that the total value of such products was $51,405,260 in 1917. Of this amount 93 per cent., or $47,778,081, represents the value of the salmon products which consist of 5,947,286 cases of canned salmon, valued at $46,304,090, and 16,347,367 pounds of mild-cured, pickled, dry-salted, fresh and frozen salmon, valued at $1,473,991. The halibut fisheries rank second with an output of products valued at $1,120,226. In the order of production, the herring fisheries come next, with a yield of products valued at $767,729. The value of the cod products was $744,976. Whaling operations returned products worth $653,852. The production of miscellaneous fishery products including clams and other shellfish aggregated $340,396 in value.

This unprecedented yield of fishery products in Alaska at a time when the world is in need of food is called an achievement for which the country may justly feel gratified.

The fur products of Alaska are also of considerable importance and value, as evidenced by the fact that in the year from November 16, 1916, to November 15, 1917, shipments from that territory reached an aggregate value of $1,031,638, exclusive of fur-seal skins and fox skins shipped by the government from the

Pribilof Islands. In the calendar year 1917 the government shipped from the Pribilof Islands fur-seal skins valued at $274,291 and fox skins valued at $35,680.

BOTANICAL ABSTRACTS

A meeting of editors of botanical publications was held at Pittsburgh, on December 28, 1917, to consider the desirability of undertaking the publication of an abstracting journal for botany. After a long discussion the following resolution was adopted:

Resolved, that we, as a group of botanists interested, invite each botanical society to appoint a committee of two to meet with committees of other societies and with the members of this group to formulate a program for a journal of botanical abstracts, botany to be interpreted in its broadest sense. In case action of any society is delayed, the President and Secretary of such society are invited to represent it. A meeting is called for 10 A.M., December 30, at Parlor 140, Fort Pitt Hotel.

At this augmented meeting of December 30, after informal discussion it was voted that the 26 botanists present proceed to formal organization under the name "Temporary Board of Control of Botanical Abstracts." Donald Reddick was elected chairman and Forrest Shreve secretary. On motion it was voted that the board provide for its perpetuation in the following way:

1. That the following botanical organizations be asked to elect two members each:

American Association for the Advancement of Science,
American Genetic Association,
American Microscopical Society,
American Phytopathological Society,
American Society of Agronomists,
American Society of Naturalists,
American Conference of Pharmaceutical Faculties,
Botanical Society of America, General Section,
Botanical Society of America, Physiological Section,
Botanical Society of America, Taxonomic Section,
Ecological Society of America,
Paleontological Society of America,
Society for Horticultural Science,
Society of American Bacteriologists,
Society of American Foresters.

2. That in the election of members to the Board of Control of Botanical Abstracts each society be asked to name one man for a short term of two years and one man for a long term of four years, and that a member be elected biennially thereafter or as required.

On motion the Temporary Board of Control elected by ballot an Executive Committee of Ten on Organization, to act for one year with power to make arrangements for editorial management and publication. This committee is constituted as follows: J. H. Barnhart, Henry C. Cowles, B. M. Duggar, C. Stuart Gager, R. A. Harper, Burton E. Livingston, F. C. Newcombe, Donald Reddick, C. L. Shear and Forrest Shreve.

The Executive Committee of the Temporary Board of Control selected B. E. Livingston for editor-in-chief and the following as associate editors in charge of the sections as indicated:

Agronomy and Soil Technology, ——— ———,
Bacteriology, H. J. Conn,
Botanical Education, C. Stuart Gager,
Cytology, C. J. Chamberlain,
Ecology and Plant Geography, Henry C. Cowles,
Forestry, Raphael Zon,
Genetics, G. H. Shull,
History, Biography and Bibliography, J. H. Barnhart,
Horticulture, W. H. Chandler,
Morphology, E. W. Sinnott,
Paleobotany, E. W. Berry,
Pathology, Donald Reddick,
Pharmacognosy, Henry Kraemer,
Physiology, B. M. Duggar,
Taxonomy, J. M. Greenman and J. G. Schramm.

It is expected that the work of abstracting will begin at once, with the international literature of the year 1918 and that publication will follow promptly.

SCIENTIFIC NOTES AND NEWS

In honor of Professor Emeritus John J. Stevenson, who held the chair of geology at New York University from 1871 to the time of his retirement from active service in 1909, the building to be occupied by the Faculty Club has been named Stevenson Hall. It was presented to the university at the commencement exercises on June 3.

Dr. Abraham Jacobi, the distinguished New York physician, who is still in active practise, received many congratulations on the celebration of his eighty-eighth birthday, which occurred recently.

The honorary fellowship of the Royal College of Surgeons in Ireland has been conferred on Major Harvey Cushing, of the United States Medical Service, on leave of absence from Harvard University.

Dr. Joel E. Goldthwait, director of military orthopedics with the American Expeditionary Force in France, has been made a lieutenant-colonel.

Major Roger I. Lee, chief medical officer of the Harvard surgical unit which sailed a year ago, has been appointed commanding officer in place of Colonel Patterson.

Dr. Frank D. Adams, dean of the faculty of applied science and professor of geology, McGill University, has left for England and France to take up work in connection with the organization of the "Khaki University for Canadian Soldiers Overseas."

Mr. H. Foster Bain has been appointed assistant director of the U. S. Bureau of Mines and is in the office of the bureau at Washington.

Dr. George V. N. Dearborn has been commissioned a first lieutenant in the Medical Reserve Corps.

Dr. R. B. Teachout, instructor in psychology in the University of Oregon, has entered the psychological service of the national army and is now stationed at Camp Lewis, American Lake, Washington.

In accordance with the recommendation of Professor Ruthven, director of the Museum of Zoology of the University of Michigan, Mr. Calvin Goodrich, editor of the *Detroit Journal*, has been appointed to the honorary position of associate curator of Mollusca.

William P. Studdert has been appointed fishery expert on the steamer *Albatross*.

Dr. Robert G. Caswell has resigned as assistant professor of chemistry at Colby College, to accept a position as one of the research chemists for the E. I. du Pont de Nemours Company of Wilmington, Del.

Dr. C. H. Shattuck, professor of forestry at the University of California in charge of range management, has accepted a position for the summer as technical adviser to the field parties now engaged in classifying the public domain lands of the west, which are now open for settlement under the 640-acre Homestead Act. Four parties are at present being organized in Montana, who will report on the grazing value of large bodies of this land.

S. F. Hildebrand, director of the Beaufort Biological Laboratory of the Bureau of Fisheries, is engaged in cooperation with Dr. C. W. Stiles, of the Public Health Service, in the campaign for the control of mosquitoes in the environs of Camp Hancock, near Augusta, Ga.

Professor Harold Heath, of Stanford University, who has made a number of visits to the seal islands as an assistant of the Bureau of Fisheries, has been engaged to go there this year for the purpose of making special investigations, assisting in the annual census, and advising the agents regarding various matters connected with the animal life on the islands.

The *Journal* of the American Medical Association states that Dr. Charles W. Young, dean of the Union Medical College, Peking, China, has gone to Shansi, taking with him Dr. Chang of the staff of the college, who has had experience in work with the plague in Tientsin. His mission is educational, and he hopes to persuade the governor of the province to stop traffic on the Hwang-Ho River which flows through Saratsi where pneumonic plague is very prevalent. In one town north of the Great Wall, it is said that 1,000 persons died from the disease in five days.

At a meeting of the Iron and Steel Institute on May 3 awards of £100 from the Carnegie Research Fund were made to Mr. George Patchin, of London, an associate of the Royal School of Mines, and formerly head of the metallurgical department of Birkbeck College, to enable him to pursue research on "Semi-

steel and its heat treatment"; to Mr. J. N. Kilby, of Sheffield, for research work on "The basic open-hearth process of steel making in all its branches"; to Mr. Samuel L. Hoyt, U. S. A., to enable him to study "The foreign inclusions in steel, their occurrence and identification"; and to Professor J. A. Van den Broek, of the University of Michigan, for research work on "The elastic properties of steel and alloys."

The University of Michigan chapter of Sigma Xi, on May 28, initiated thirty new members, all of whom had been actively engaged in research. Professor A. F. Shull delivered the annual address, on the subject "Heredity and the fate of the warring nations."

Dr. Sidney D. Townley, professor of applied mathematics at Leland Stanford University, gave a lecture before the science club of the University of Oregon on May 13, on the subject "The recent earthquake at San Jacinto, California."

Dr. Martin H. Fischer, Eichberg professor of physiology in the University of Cincinnati, delivered the second Sigma Xi lecture of the 1917–18 series at the University of Missouri on May 15. His subject was "The general physiology of water absorption in the living organism." The lecture was open to the public. Dr. Fischer also lectured to the Medical Society of the University of Missouri on May 16, on "Principles of treatment in nephritis." On the evening of the same day he addressed the Missouri Chapter of Sigma Xi in connection with the annual initiation on "Emulsion chemistry and some of its applications."

It is announced that arrangements have been made for a series of special lectures at Cambridge University for the summer meeting, beginning August 1, when the main subject will be the United States of America. Among the lecturers are Professors George H. Nettleton, Henry S. Canby and Henry A. Bumstead, of Yale; Professor J. W. Cunliffe, of Columbia; Professor Santayana, formerly of Harvard, and Sir William Osler, formerly of Johns Hopkins and now of Oxford.

A national union of scientific workers is being formed in Great Britain. Norman Campbell, the secretary, writes to *Nature:* "There is a general agreement that it is imperative for the best interests of science that those who pursue it should possess greater political and industrial influence. The founders of our union believe that they can attain that influence only by adopting the form of organization which has proved effective in experience. That organization involves the formation of a union including, so far as possible, every professional scientific worker, and governed in a completely 'democratic' fashion. It is such a union that we are trying to form."

We have been requested to state that the book "A Year of Costa Rican Natural History," by A. S. and P. P. Calvert, reviewed in Science for March 1, 1918, was published by the Macmillan Company, New York, 1917.

Knud Rasmussen, the Danish explorer, according to an Exchange Telegraph despatch from Copenhagen, has reached Long's Firth with his Arctic expedition and has charted all the Firths of northern Greenland. Important scientific results, the explorer says, have been attained. Rasmussen and his second Thule expedition left Denmark in April, 1916. Reuter's Copenhagen correspondent transmits a telegram from Rasmussen in which the explorer says his advance was attended with the greatest difficulties. Two companions, Hendrik Olsen and Dr. Wulff, perished. After Olsen's death, says the explorer, "we started on our homeward journey and reached land on August 24, at Cape Agassiz in a bad plight, without provisions, having eaten all the dogs." The explorer says he and his companion walked to Etat, whence they despatched sledges with provisions for the rest of the party, but that the relief arrived too late to save Dr. Wulff.

A medical school for French Africa has been founded at Dakar. This school will be under the authority of the director of the Service de Santé, inspector general of the sanitary and medical services of French West Africa, and will have for its mission the training of native physicians and midwives. The

construction and organization of this school shall be, according to the decree, undertaken at once by the governor general so that the necessary funds will be forthcoming as provided for by this law.

AT the seventeenth annual meeting of the North Carolina Academy of Science, held at Greensboro on April 26 and 27, Dr. E. W. Gudger, after ten years' service as secretary-treasurer, was made president for the next year. The other officers elect are: *vice-president,* Professor H. B. Arbuckle, Davidson College; *secretary-treasurer,* Mr. Bert Cunningham, Trinity College; additional members *executive committee;* Rev. George W. Lay, St. Mary's School; Professor Gertrude W. Mendenhall, State Normal College and Professor J. J. Wolfe, Trinity College.

UNIVERSITY AND EDUCATIONAL NEWS

THE Rockefeller Foundation has made the following appropriations: Howard College, Birmingham, Ala., $100,000; Wake Forest College, Wake Forest, N. C., $100,000, and Meredith College, Raleigh, N. C., $75,000. The board granted $195,000 for state agents for negro rural schools and for the annual maintenance of negro schools in the south. It also appropriated $14,000 for farm demonstration work in Maine and New Hampshire.

AT the University of Kentucky Dr. C. A. Shull, of the University of Kansas, has been appointed head of the department of botany; Dr. C. B. Cornell, of the University of Nebraska, assistant professor of education, and W. D. Funkhauser (Ph.D., Cornell) head of the department of zoology.

AT the University of Chicago, the following promotions have been made: To a professorship, Preston Keyes, anatomy; to associate professorships: Herman I. Schlesinger and Jean Piccard, chemistry; to assistant professorships: Gerald L. Wendt, chemistry; Charles C. Colby, geography, and Morris M. Wells, zoology; to instructorships: Merle C. Coulter, botany; Carl Richard Moore, zoology.

AT the University of Michigan Associate Professor Arthur J. Decker has been promoted to be professor of sanitary engineering. Walter C. Drury has been made instructor in sanitary engineering.

DISCUSSION AND CORRESPONDENCE

ON THE ANTIQUITY OF MAN IN AMERICA

IT is not from choice that the writer again ventures to take part in the controversy regarding the antiquity of man in America, but the reported discovery of remains of man associated with those of fossil animals of Pleistocene age at Vero, Florida, has reopened the question of antiquity and presents such possibilities of erroneous interpretation that I feel impelled to offer a word of caution.

The American aborigines as known to us have occupied every available part of the continent from the Arctic to the Antarctic throughout the long but illy defined period known as the Recent, and their osseous remains and the relics of their handicraft have become associated with unconsolidated superficial deposits by burial, and by the changes, often very profound, which take place everywhere through the action of wind, water and gravity and especially along stream courses; and in the passage of the centuries and millenniums it is patent that the relations of human remains and relics of all classes have been subject not only to minor but often radical changes in their relation to one another and to the original formations and surface of the occupied areas.

The full significance of these conditions is seldom realized or but imperfectly recognized by those who seek the early traces of man's presence and who venture to reckon the period of his arrival. The stream, for example, that meandered a valley or plain thousands of years ago may ere this have rearranged the materials of large areas along its course. Its channel may have worn its way back and forth over miles of territory, yet the formations thus effected may be so reset, though largely at reduced levels, as to obliterate traces of disturbance. Changes in the chronologic rela-

tion of inclusions in sloping and rolling country may have been similarly effected without leaving distinguishable traces. It is the failure to recognize these important considerations that has led in many cases to the confident and regrettable announcements on the part of students respecting the original association of human remains with the remains of fossil animals of the earlier periods.

It is not the Vero evidence, however, which requires particular attention at this time, since the interpretations favoring great antiquity are fully offset by the interpretations of anthropologists of long experience in the consideration of problems of the history of man in the world and the evidence relating thereto, but because questions of wide range have been opened through the revamping by Dr. Hay of a large body of so-called evidence of geological antiquity which has long been discredited and relegated to the historic scrap heap where it should still remain.[1]

There is a peculiar and very strong fascination in the idea of hoary antiquity and on the part of many students a disposition to discover parallels between the early events of human history in the old and new worlds, and the gathering of data bearing on these ideas becomes an obsession. Had certain of our archeologists in past decades not met with strenuous opposition glacial man in America would long ago have been fully "established." We should now have in our museums large collections of American paleolithic implements duplicating in nearly every respect the paleoliths of Europe and no end of bones of Pleistocene man and if now such views as those of Dr. Hay are allowed to prevail we shall have to accept the conclusion that American man had advanced to the pottery-making stage in the middle or early Pleistocene, and that after the lapse of a vast period the art was revived by the same or another people using the same materials, employing similar methods and attaining identical results in the same region—a marvel without parallel in the history of man.

[1] *American Anthropologist* (N. S.), Vol. 20, No. 1.

It is manifestly a serious duty of the archeologist and the historian of man to continue to challenge every reported discovery suggesting the great geological antiquity of the race in America and to expose the dangerous ventures of little experienced or biased students in a field which they have not made fully their own.

Dr. Hay has published a map giving locations of finds of traces of man attributed to the Pleistocene, these in cases being associated more or less intimately with remains of *Elephas imperator*. But this association is open to different interpretations and I feel justified in raising the danger signal in each and every case since, if left alone, lamentable errors may become fixtures on the pages of history. I therefore hasten to relabel the map "Danger Signals for the Student of Human History."

I do not wish for a moment to stand in the way of legitimate conclusions in this or any other field of research, but illegitimate determinations have been insinuating themselves into the sacred confines of science and history with such frequency and persistence that no apology is required for these words of caution.

W. H. Holmes

Department of Anthropology,
U. S. National Museum

NOTE ON SUDAN III

The toxicity of this dye, used so extensively in the study of problems connected with fat metabolism and vital staining, is a question of considerable importance; on this account a preliminary notice is presented of the finding that the preparations now on the market are of very doubtful purity.

Mendel and Daniels once stated that large doses of this dye fed to cats were harmless, provided the dye was pure. A preparation put up by an American manufacturer was given by them in large doses to two cats, which subsequently died within a comparatively short time, apparently from the effect of some impurity in the dye.

Some years later Salant & Bengis in their pharmacological study of fat soluble dyes stated that rabbits fed 1.7 gm. per kilo died in

one to three weeks, but it was extremely doubtful whether death was due to the dye.

Experiments carried out in this laboratory with three German preparations and one of American make show great variation in general physical and chemical properties. Melting points vary by as much as 70 degrees, the color of solutions in oil range from a deep orange to a venous red, and their degree of solubility in neutral, alkaline or acid solutions is not the same.

The impure preparations were found in every case to be highly toxic, causing rabbits to die within 24 hours.

Full details of the completed experiments will be published later.

B. E. Read

Yale University

SCIENTIFIC BOOKS

Lord Lister. By Sir Rickman J. Godlee, Bart., pp. xix, 6761. Macmillan & Co., Ltd. London. 1917.

This is the biography of a man who never wrote a book yet whose work so profoundly transformed surgery that "Before Lister" and "After Lister" in surgical chronology are the counterparts of B.C. and A.D. in Christian chronology!

As a biography the story is too detailed to be easy perusal for the non-medical reader as compared, for example, with Vallery-Radot's "Pasteur"; but as the authorized biography by Lister's nephew and assistant, who had access to all his letters, remarkable commonplace books and other data, and as a narrative intended to trace the development of Lister's antiseptic system for the enlightenment of the profession in future ages, it is none too long nor too minute. It is more than a biography. It is an important historical document.

Joseph Lister was born a Quaker and continued in the Society of Friends until his marriage with the daughter of his professor of surgery, Mr. Syme, in 1856, when he withdrew from the society and later joined the Episcopal Church in Scotland. In his correspondence with his family, however, he always used the plain language, but in a *form* which differs from that of our Philadelphia Friends and often grates upon both eye and ear. He simply replaces "you" by "thee," the plural verb being retained, *e. g.*, Thee say, are, have, etc.

He witnessed the first operation ever performed in Great Britain under ether anesthesia by Liston in December, 1846. Yet as Godlee points out it was hard to displace the old slap-dash surgery which was no longer necessary when pain had been abolished. Yet even in my own student days (1860–62), I have seen stop-watches pulled out to time how many seconds were required by Gross and Pancoast to whip a stone out of the bladder.

Lister's first work was in anatomy and pathology, especially in inflammation. Few remember that it was he who in 1853 first demonstrated the circular and the radiating muscular fibers in the iris.

A visit to Edinburgh for observation changed his whole life, for he settled there first as a student, then as an extra-mural lecturer, and there found his model wife whose death in 1893 was such a terrible blow to him.

In 1860 he was appointed regius professor of surgery in Glasgow. The very next year he attributed suppuration not to the oxygen of the air as all the chemists and everybody else were teaching, but to fermentation. His first two papers introducing the antiseptic system were not published until 1867.

Sir Rickman gives an excellent account of the warfare on "hospitalism" and puerperal fever by Simpson, Erichsen and Semmelweiss, but does not even mention our own Holmes, whose finger pointed the way as early as 1843. The echoes of his battle royal with Meigs and Hodge, of Philadelphia, were still reverberating when I was pursuing my medical studies. The methods of treatment of wounds which I was taught, and which I practised during the Civil War and down to 1876, are well described. Then follows a discussion of fermentation and putrefaction, and next the history of the rise and progress of Lister's antiseptic system, its modifications and its eventual triumph.

The "Story of the Four Flasks," which became, as Godlee well says, "classical," is finally completely told. These were partly filled with fresh urine, boiled, their necks drawn out to 1/12th of an inch in diameter and all left open to the air. The neck of one was left vertical, those of the other three were bent downward. The contents of the vertical necked flask soon putrified. The other three travelled with him from Glasgow to Edinburgh and thence to London, where they were accidentally destroyed by fire *ten years* after being prepared as described. During all these ten years the urine remained clear and undecomposed! If for ten years, why not undecomposed for a century!

The two chapters describing the reception of Lister's antiseptic system by the profession "at home" and "abroad" are most interesting. After nine years in Glasgow, Lister succeeded Syme in the chair of clinical surgery in Edinburgh, where his success as a teacher was as immediate as it had been in Glasgow, where he had "taken the students by storm." Here he created a school of enthusiastic pupils who in time won hospital positions as didactic and clinical teachers and practised antisepsis.

In 1877, at the age of fifty, he went to London to King's College as the successor of Sir William Fergusson, who had been easily and for long the foremost surgeon of the metropolis. But what a contrast! What a chilling frost! Instead of over 180 as at Edinburgh, the number of new students annually was less than 25! At his lectures the present distinguished surgeon, Sir Watson Cheyne,—one of four assistants who had gone with Lister from Edinburgh to London, as he had stipulated—was careful to attend, so that at least there might be a dozen auditors! "We four unhappy men . . . wandered about . . . the wards in other hospitals where the air was heavy with the odor of suppuration . . . and the flushed cheek spoke eloquently of surgical fever." In Edinburgh Lister had had "half a dozen wards with 60 or 70 patients" whereas at King's he had "only two wards . . . but only *empty beds*"! The extraordinary domineering conduct of the nurses at King's will seem very strange to American surgeons and nurses.

In the London medical societies discussions on antisepsis were either listless or else hostile. Most of the surgeons did not really grasp the fundamentals of the system. Even Paget dressed a compound fracture of the leg by putting on collodion *at once* and then *12 hours later* applied carbolic acid! Yet he declared that the treatment "did no good" though he had taken "special care" to follow Lister's method! Mr. Savory, one of the leaders and surgeon to "Bart's" itself, in 1879 considered that an annual average of about 6 cases of pyemia, 20 of erysipelas and 26 of blood poisoning represented as good a result as it was reasonably possible to expect!

In 1876 in connection with the Centennial in Philadelphia, we held an International Surgical Congress. There I saw, heard and met Lister for the first time. The general tone of the discussion in the surgical section of which Lister was chairman, with the exception of a few, was that the system was little if anything more than "surgical cleanliness"! I was an attentive listener, was wholly converted to Lister's views and began to practise his method when I went on duty at St. Mary's Hospital, October 1, 1876, and have never for a moment ceased to be an enthusiastic disciple. My results were marvellously different from what they had been in the same hospital for ten years. "Experientia docet." I *know* whereof I speak by bitter prior experience.

On the Continent, Saxtorph, Thiersch, Volkmann, Nussbaum, Championnière and others very early accepted the method and improved it. Then it came back re-vamped as it were to London, and finally, has won its way in a triumphant progress all over the civilized world.

Honors had begun to come thick and fast. The presidency of the Royal Society, degrees and honorary memberships from everywhere, a baronetcy and finally the peerage and the Order of Merit, limited to 24, and Lister was one of the first 12.

Then alas came the declining day with loss of physical and at last of mental vigor and finally the last closing of the eyes and a tablet in the Abbey.

Lister lived too long. It is better that every man should go before declining powers betray him. Strange to say both he and, if one may judge from various hints, his biographer also are disposed to be *laudatores temporis acti,* and mourn what seems to me a natural and inevitable development from antisepsis to asepsis, but which they regard as "a heresy."

So far from Lister's "practise having been discarded and his theory exploded" they have never been so firmly entrenched as now. Asepsis well suits civil practise in "clean" cases, but not in deeply infected cases. The Great War has recalled us to antisepsis, by reason of the intensity of its infections. The Carrel-Dakin method employs better antiseptics than carbolic and better methods of disinfection than Lister ever knew. The bacteriologist and the surgeon working together determine when a wound may be closed with assurance of success. Moreover if we can treat contaminated wounds early, before the bacteria have penetrated deeply and remove all the devitalized tissue and on and in it the great majority of the bacteria, the phagocytes can care for the remaining mild infection. Immediate closure may then be made.

It has remained for a non-medical snarling Irish critic, whose colossal egotism will readily suggest his name, and an anonymous medical reviewer both in the *Nation* (London) and another writer in the English *Review* whose article I have not seen, to belittle Lister and declare that he was not a great man.

With me the opinion of such judges as Volkmann, Virchow, Pasteur, Weir Mitchell and Lord Kelvin and the homage of thousands at the Great Congresses in London, Amsterdam, Philadelphia, Berlin, Montreal and elsewhere are enough. His detractors will have their day and cease to be, but "Humanity with uncovered head will salute" the Great Benefactor.

Is not my opening sentence correct?

Of course I had expected the superfluous "U" (a sort of intruding philological U-boat) in "tumour, labour," etc., although the Latin originals of all such words have no "u." Even the N. O. D. has "actor, also actour"! I must confess to surprise when I found the archaic "plaister" (which the N. O. D.) prints but marks "obsolete") especially as Lister himself wrote "plaster."

W. W. KEEN

NOTES ON METEOROLOGY AND CLIMATOLOGY

THE "OLD-FASHIONED" WINTER OF 1917-1918[1]

EVEN though summer is upon us, it is not difficult to recall that last winter in the United States east of the Rockies was remarkably cold and snowy. The first killing frosts of autumn came early, and nipped crops which had started late and grown slowly in the cold spring and early summer. The South had a real winter, much to the detriment of fruit and truck crops which were caught by frost. By far the most intense winter conditions occurred in the regions from the Ozarks to New England, where low temperatures brought snow with passing cyclones, and the snow-cover in turn cooled the air excessively whenever the sky was clear. The unprecedented snow and ice blockades brought the well-known, long chain of uncomfortable and costly results.

In the eastern United States it was not surprising that autumn months which in many regions were the coldest on record, should be followed by a December and a January that defied the memories of the oldest inhabitants. For example, in Ohio, a 64-year record fails to show a colder December, and in New England, January seems to have been the coldest month at least since 1836, if an Amherst record may be considered as representative. In these cold months, new minimum temperatures were established broadcast. Early in December, for instance, temperatures as low as 20° to 31° below zero (F.) were observed

[1] A more extensive account is to be found in the *Geographical Review,* May, 1918, Vol. 5. This is based essentially on serial publications of the Weather Bureau, and on some press reports.

from western Tennessee to southern Ohio where the snow was deep at the time. One Weather Bureau observer in West Virginia reported a minimum of —37° F.; and another in Iowa, —40°. Extreme minima, —45° F., established new low records for South Dakota and Maine. On January 12, "that cold Saturday," a true blizzard with snow driven by a gale at a temperature down to 20° below zero (F.) tied up traffic almost completely for two days in the Middle West.

Relative to the cold land or snow surfaces, the open waters of the Great Lakes, Atlantic and Gulf were excessively warm; therefore they favored the development of numerous cyclones—some of them very intense. These supplied the snow which blockaded the railroads, or the rain which produced such disastrous floods in the ice-gorged rivers.[2] In the immediate vicinity of the Great Lakes, snow fell almost daily in January; and with many heavy falls, reached totals of 3 to 5 feet in that month alone. Chicago with 42 inches and Milwaukee with 53, saw the worst snow conditions in their histories. Farther south, in a belt from the Ozarks to the upper Ohio River, equally large amounts of snow were precipitated in January by the cyclones passing on the south, around the edge of the cold snow blanket. October and December were snowier than usual, especially December, in much of the eastern half of the country.

The weather was extraordinary not alone in the eastern United States: west of the Rockies the winter was one of the warmest on record. Extreme dryness prevailed in the southwest; but extraordinary rainfall occurred in the northwest. In December a temperature of 86° below zero (F.) was reported from the Upper Yukon, at the mouth of the Pelly River. If authentic, this established a record for North America which is only 4° (F.) below the earth's extreme surface minimum —68° C. (—90.4° F.), observed in Siberia in 1892.[3] Northern Sweden at about the same time had unprecedented coldness —57° C. (—70.6° F.) at Asele, and reports from Spain, central plateau of France and southwestern Asia tell of a winter of extreme severity.

Why is the world having such unusual weather? This is a period of sun-spot maximum—a time when solar radiation comes to its maximum; a condition occurring on the average once in 11 years.[4] Experience has shown that at such times there is a general tendency in winter to strong continental anticyclones and ocean cyclones; with corresponding storminess and coolness.[5] For North America, a strong winter anticyclone generally seems to favor coldness in the east and warmth in the west.[6] Locally, the snowiest and coldest weather occurs where, in spite of low temperatures, the supply of moisture is abundant and the temperature contrasts produce the storminess requisite to precipitate it as snow. Then this snow keeps the air cold and helps to make more snow; until important changes in general winds dominate the weather and eliminate the snow-cover—as was the case early in February, 1918. While the present degree of solar activity lasts, further occurrences of extreme weather are not unlikely.

METEOROLOGY IN THE ARMY AND NAVY

SINCE weather has much to do with military operations, especially flying,[7] it was natural that before one month had passed after the entry of the United States into the war, instructors had been sent to the flying school at Toronto for preparation to teach meteorology at the six new aviation ground schools in the United States. This work has progressed quietly ever since. Professor R. DeC. Ward,

[2] See *Mo. Weather Rev.*, Feb., 1918.

[3] See note, "The Lowest Air Temperature at a Meteorological Station," *Mo. Weather Rev.*, Vol. 45, 1917, pp. 407–408.

[4] For a further discussion, see C. G. Abbot, "The Sun and the Weather," *The Scientific Monthly*, Vol. 5, Nov., 1917, pp. 400–410.

[5] *Cf.* H. Arctowski, *Bull. Am. Geog. Soc.*, 1916, Vol. 42, pp. 270–282.

[6] See T. A. Blair, "Some Temperature Correlations in the United States," *Mo. Weather Review*, Vol. 45, 1917, pp. 444–450.

[7] *Cf.* R. DeC. Ward's most recent articles, *Scientific Monthly*, February and April, 1918; and in *Jour. of Geography*.

the instructor in aeronautical meteorology at the U. S. Army School of Military Aeronautics at the Massachusetts Institute of Technology, has published a syllabus of his course of ten lectures,[8] and also the essentials of these ten as condensed into three lectures.[9] This presentation of "Meteorology and War-Flying" gives the essence of what the aviator needs to know, and contains full references to this rapidly developing application of meteorology. Major (formerly Professor) Wm. R. Blair has prepared a report on "Meteorology and Aeronautics,"[10] the purpose of which is "to show the sort of atmospheric data available and to put the subject in such shape as may make it bear directly on the problems which are met in aviation."

While the aviators were being trained, the Signal Corps was establishing its meteorological service abroad. As the first contingents of the American Army went overseas, Majors W. R. Blair and E. H. Bowie, appointed respectively from the aerological and forecasting divisions of the Weather Bureau, were put in charge of the meteorological work. In November those responding to a call for a large number of meteorologists were given a period of intensive training at more than a score of Weather Bureau stations. Professor W. J. Humphreys's new book, "The Physics of the Air," which is being published in the *Journal of the Franklin Institute,* was of great help to the more advanced students. This work is a highly valuable contribution to the science, for it covers the fundamentals of meteorology in such a way that it can be used readily as an advanced text-book.

More meteorologists are needed. So a Signal Corps School of Meteorology has been established at College Station, Texas. Here over 300 meteorologists, physicists, engineers and other technical specialists are about to begin an 8-week course in meteorology. Dr. Oliver L. Fassig, from the Weather Bureau at Baltimore and Johns Hopkins University, is chief instructor. There are to be three assistant instructors: Mr. W. T. Lathrop, from the Weather Bureau at Greenville, S. C., for instruments, observations and map-making; Lieutenant Wm. S. Bowen, for the aerological work; and Dr. C. F. Brooks, from Yale University, for the course in general meteorology. About thirty of the Weather Bureau men in the school will also assist in instruction.

In addition to this training of specialists—and perhaps induced thereby—are the short courses in meteorology included in the military instruction of the Reserve Officers Training Corps in many universities.

Meteorology in the navy has been developed by Lieutenant Commander Alexander McAdie, in charge of the aerographic section, and trained men are in service overseas and in this country. A school for men taking up this work is maintained at Blue Hill Meteorological Observatory under the guidance of L. A. Wells, chief observer and forecaster of the observatory.

Naval training units at the universities, are now, or will soon be, receiving instruction in marine meteorology.

The importance of meteorology has never before received such wide recognition, and in view of the permanent development of aeronautics, it seems safe to predict that hereafter it will always hold a more important position in the curricula of the universities.

CHARLES F. BROOKS
COLLEGE STATION, TEXAS

[8] SCIENCE, July 27, 1917, Vol. 46, N. S., pp. 84–85.

[9] *Mo. Weather Rev.*, Washington, December, 1917, Vol. 45, pp. 591–600.

[10] Report No. 13, 1917, National Advisory Committee for Aeronautics, Washington, D. C.

SPECIAL ARTICLES

CONCERNING SELECTIVE PERMEABILITY

IN most cases in living organisms, cell permeability does not even seem to violate the known physico-chemical laws. There are, however, several exceptions, notably in the intestines and kidneys, where the permeability is selective.

In considering the membranes that seem to disturb osmotic laws, it is often stated that they cause these disturbances because the

membranes are living, as though that were sufficient explanation. Are not the membranes that do obey the laws living, too? Those membranes through which certain substances can pass from a lower to a higher concentration are very probably different from the membranes used in experimental work. It is only by assuming that the membrane plays an active part in determining this one-sided permeability that the thermodyamic laws are brought into question. The sieve theory, even when so modified as to render negative osmosis[1] available, does not seem convincing. No gradation of molecules in the membrane, either of concentration or kind, allowing the solute to pass from one molecule to another, could possibly explain the facts. Nor does the theory of the funnel-like arrangement of lipin molecules,[2] ingenious though it be, allay one's curiosity. However, there is no doubt that most of the recent ideas on this question have been correct in postulating structures as a necessity in any explanation of this elusive (vitalistic) phenomenon.

Wherever selective permeability occurs there is at least one layer of cells through which the solute has to pass. It is inconceivable that if all parts of these cells were exactly alike there would be selective action. But there seems to be no theoretical difficulty provided certain differences exist. The two membranes in contact with the two fluids need to be different. The substance under consideration easily passes the membrane on the entering side of the cell, but passes either not at all, or with great difficulty the membrane on the exit side of the cell. In the cell a chemical change occurs in the substance that has entered. After this change it can pass the second membrane easily, but passes only with difficulty the membrane by which it gained entrance.

It is not necessary to assume a profound change to make conditions favorable for this differential solubility. But it is necessary that the substance formed should exist in higher concentration than the original substance when the two are in equilibrium. A change from an alkaline to a neutral or acid medium, involving a change from a sodium salt to the free compound or to, say, the chloride would be sufficient, or a synthesis of the entering compounds to more complex ones would suffice to make the theory plausible.

Because of our ignorance of just what happens in these membranes and cells, it can not be stated with certainty that specific changes do occur in a substance on passing through the cells and membranes. But the conditions necessary for such chemical and physical alterations seem to exist. The probabilities in this hypothesis can be more readily appreciated by taking an example.

The fats are hydrolyzed in the intestines to the sodium soaps. These sodium soaps, but not the fats, are able to pass the intestinal wall membrane. On entering the cell space inside the wall, the soaps are not free to pass on to the lymph or blood, because of the comparative impermeability of the second membrane to the soaps. While between these two membranes the soaps are synthesized to fats by the aid of enzymes in the presence of glycerol. Now these fats are able to pass through the second membrane to the lymph or blood; but the membrane on the intestinal side is comparatively impermeable to the fats. It is thus evident that there is reason for much higher concentration of fat in the lymph than in the intestines.

Though this illustration was chosen because it fits the theory, there is no inherent reason why the same conditions should not apply, say, to the absorption of the amino acids. They may be absorbed by intestinal cells as the sodium salts, then be changed to free amino acids, and pass thus to the blood. It is not necessary to assume that the compound exists in the same form in the blood as in the intestinal cell. It may change to any conceivable compound after passing the second membrane, may even change back to the one that passed the first membrane. There is more difficulty in accounting for the selective permeability of membrane cells in the case of rather

[1] F. E. Bartell, *J. Am. Chem. Soc.*, 36, 646 (1914).

[2] T. B. Robertson, Science, 45, 567 (1917).

inert chemical substances, such as the passage of sugars through the intestines or of urea through the kidney. But no decided changes in the molecules seem necessary. The conditions in the membrane cells may be favorable for weakly combined synthetic derivatives with the right solubilities. When we realize how susceptible to small differences in salts the membranes are, it is not impossible that some particular salt of the passing substance may be all that is necessary to determine its ready exit. If all other ideas fail in any given case, one can always fall back on the ever-ready help of the all-pervasive enzyme.

Several other writers have stated that these selective membranes behave as though a genie stood at the opening in the membrane, allowing the molecules from the side of lower concentration to pass, while closing the door to those moving in the opposite direction. It is evident that a space in which the proper chemical reaction occurs, and which is situated between the two different membranes with the proper permeabilities, functions like our anthropomorphic genie.

It is rather apparent that the idea outlined above is about half way between that of ordinary permeability and secretion. Though it does have many points in common with secretion, it seems wise not to confuse the two; for it is clear that they are different in the purpose served as well as in the method of obtaining their results.

If the attention is confined to the isolated system, solution one, the cell membrane as a whole, and solution two with concentration greater than solution one, the law of the conservation of energy is not obeyed. This might be urged as evidence of vitalism. But closer scrutiny will show that the necessary energy to run this system comes from outside. The substance necessary for the chemical reaction has to be formed and sent to the proper place. If this substance is derived from solution *two* directly, energy equivalent to that produced in the combination must be supplied to dissociate the complex. And energy is necessary to transport this substance back again to the permeability cell. Energy is also consumed in maintaining the cell structure. Even in a living organism one hesitates to start a perpetual motion theory, partly because it is such a lazy way of settling a difficulty, and partly because it would necessitate a later disillusionment.

C. G. MACARTHUR

MEDICAL SCHOOL,
STANFORD UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION B

THE section convened at Pittsburgh at 10 A.M., December 27, 1917, in Room 209 of the School of Applied Science, Carnegie Institute of Technology. Its sessions, jointly with those of the American Physical Society, extended over a period of three days. The scientific papers presented under the auspices of the American Physical Society are as follows:

"*The optical properties of rubidium*," by J. B. Nathanson, Carnegie Institute of Technology.

"*A preliminary study of the luminescence of the uranyl salts under cathode ray excitation*," by Frances G. Wick, Vassar College, and Louise S. McDowell, Wellesley College.

"*Note on a phosphorescent calcite*," by E. L. Nichols and H. L. Howes, Cornell University.

"*The visibility of radiation in the blue end of the visible spectrum*," by L. W. Hartman, University of Nevada (communicated from the Nela Research Laboratory, Cleveland).

"*An improved form of mercury vapor air pump*," by Chas. T. Knipp, University of Illinois.

"*Heat conductivity of cerium*," by C. N. Wenrich and G. G. Becknell, University of Pittsburgh.

"*Temperature and heat of fusion*," by J. E. Siebel, Chicago.

"*Report on the construction of certain mathematical tables*," by C. E. Van Orstrand, U. S. Geological Survey, Washington, D. C.

"*Mobilities of ions in vapors*," by Kia-Lok Yen, University of Chicago.

"*The size and shape of the electron*," by Arthur H. Compton, Westinghouse Lamp Company.

"*The coefficient of emission and absorption of photo-electrons from platinum and silver*," by Otto Stuhlmann, Jr., University of Pennsylvania.

"*Ionization and excitation of radiation by electron impact in nitrogen*," by Bergen Davis and F. S. Goucher, Columbia University.

"*Energy in continuous X-ray spectra*," by C. T. Ulrey, Columbia University.

"*An experimental investigation of the characteristic X-ray emission from molybdenum and palladium,*" by Benjamin A. Wooten, Columbia University.

"*Characteristic X-ray emission as a function of the applied voltage,*" by Bergen Davis, Columbia University.

"*A standard of sound*" (demonstration), by Chas. T. Knipp, University of Illinois.

"*The air damped vibrating system: theoretical calibration of the condenser transmitter,*" by I. B. Crandall, American Telegraph and Telephone Company and The Western Electric Company.

"*A photographic method of measuring the velocity of sound waves near the source of sound,*" by Arthur L. Foley, Indiana University.

"*The effect of intensity and distance on the velocity of sound,*" by Arthur L. Foley, Indiana University.

"*The influence of the pressure and time employed in condensing a dental amalgam upon its crushing strength, at temperatures between 10° and 100° C.,*" by Arthur W. Gray and Paris T. Carlisle, The L. D. Caulk Company.

"*Absorption in paraffined paper condensers,*" by L. Pyle, Washington University, St. Louis.

"*An interesting case of resonance in an alternating current circuit,*" by H. L. Dodge, The State University of Iowa.

"*On electromagnetic induction and relative motion II.,*" by S. J. Barnett, Ohio State University.

"*Eddy-current and hysteresis losses in iron at high frequencies,*" by C. Nusbaum, Harvard University.

"*Some energy transformations with oscillatory currents,*" by E. F. Northrup, Princeton University.

"*The effects produced upon audion characteristic curves by different kinds of signals (Buzzer Electron Relay and 60-cycle A. C.),*" by A. D. Cole, Ohio State University.

"*Influence of a series spark on the direct current corona,*" by S. F. Crooker, University of Illinois.

"*On the effect of a magnetic field upon cathode rays,*" by L. T. More and Lowell M. Alexander, University of Cincinnati.

"*The physical characteristics of X-ray fluorescent intensifying screens,*" by Millard B. Hodgson, Eastman Kodak Company.

"*Barometric ripples,*" by W. J. Humphreys, U. S. Weather Bureau, Washington, D. C.

"*The ultra-violet and visible absorption spectra of phenolphthaleins,*" by W. E. Howe and K. S. Gibson, Cornell University.

"*The ultra-violet and visible absorption spectra of Orcinolphthaleins,*" by R. C. Gibbs, H. E. Howe and E. P. T. Tyndall, Cornell University.

"*The ultra-violet absorption spectra of acetone,*" by E. P. T. Tyndall, Cornell University.

"*Thermal conductivity of metals,*" by Edwin H. Hall, Harvard University.

"*A mercury manometer of high sensibility,*" by J. E. Shrader, Westinghouse Research Laboratory, Pittsburgh.

"*A simple gauge for very low pressures,*" by J. E. Shrader, Westinghouse Research Laboratory, Pittsburgh.

"*Resonance and ionizing potentials for electrons in magnesium vapor,*" by P. D. Foote and F. L. Mohler, Bureau of Standards.

"*The spectral photoelectric sensitivity of molybdenite,*" by W. W. Coblentz and W. B. Long, Bureau of Standards.

The papers by Messrs. Siebel, Foley, Crooker, More, Alexander and Coblentz were read by title.

On Saturday morning, December 29, at 10 A.M. the subject of discussion was "The relationship of physics to war." Addresses were made by Lieutenant G. P. Thomson, R.F.C., and by Lieutenant Giorgio Abetti, member of the Italian Military Mission. Informal reports upon the war activities of various laboratories were made by the following representatives:

Dr. A. L. Day, director of the Geophysical Laboratory.

Dr. I. B. Crandall, Research Laboratory of the Western Electric Company.

Dr. Frank Wenner, Bureau of Standards.

Mr. C. E. Skinner, Research Laboratory of the Westinghouse Manufacturing Company.

Dr. W. J. Humphreys, U. S. Weather Bureau.

The Sectional Committee announced the appointment of Professor C. T. Knipp, of the University of Illinois, to fill the vacancy on the sectional committee made by the withdrawal of G. W. Stewart.

The Section elected by ballot the following named persons:

For member of the Council: Professor Wm. Duane, of Harvard University.

For member of the Sectional Committee: Dr. H. D. Arnold, of the Research Laboratory of the Western Electric Company.

For member of the General Committee: Dr. H. S. Hower, Carnegie Institute of Technology.

G. W. STEWART,
Secretary

SCIENCE

Friday, June 14, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE VALUE AND SERVICE OF ZOOLOGICAL SCIENCE[1]

SPIRITUAL VALUES

The material values of science are often heralded, while its spiritual values pass unnoticed. Leaving all tangible values unemphasized, we shall here contend that the intangible values of science in general and of zoology in particular are the more significant. These we may characterize as "spiritual," using the term over against "material" and without further implication. Thus, if we speak of man's spiritual yearnings in contrast with his material needs, we may not have a clear idea of what this phrase implies, but we recognize in this contrast the existence of something the opposite of material. That which constitutes "the spirit of the man" is too illusive for definition, yet it is a thing we recognize as existent and in such a sense the word spiritual is used.

In the present world crisis there are none who decry the material values of science. Our very national existence depends upon them. But there are many who raise the question whether science on its spiritual side is not a failure, whether the war is not science gone mad; and we scientists need to consider what is the source of this undercurrent of criticism which sets against the freedom of science. In the eyes of the man in the street, science represents only material accomplishment and even among the educated such a belief is not uncommon. We men of science do not believe this. Why should others? Perhaps we are to blame

[1] Symposium before the American Society of Zoologists, Minneapolis, December 29, 1917.

for not having taken the public sufficiently into our confidence. If it is our belief that science has emancipated the spirit of man by freeing it from ignorance and superstition, and in so doing has brought advantages in excess of the material comforts which are the more obvious fruits of scientific progress, it is time we laid more emphasis upon these intangible values. For by these we live and work, rather than by the desires of a sordid materialism.

1. MATERIAL COMFORT AND SPIRITUAL PROGRESS

Betterment of his material surroundings reaches beyond man's physical comfort; for such betterment enables him to fix his attention upon "that which is not bread." We reach the heights now and then from the flood of difficulties which surrounds us; and there may be all the more satisfaction in this, when we do so in spite of adverse conditions, when we will not be wholly fettered by mere circumstance. Yet for sustained achievement in nation or individual there must be relief from an oppressive struggle for existence. What H. G. Wells[2] has termed "this misery of boots" must be overcome before we can realize our spiritual desires. Those who have lived as the favored members of society may prate of their superiority over material things; but one suspects that a sojourn in a New York tenement or a Pittsburgh slum would convince any one of us that he owes much of what he has accomplished to the stability of his material foundations, and to the absence of acute pressure in matters of food and shelter. Some of us call ourselves poor, comparatively speaking; but we have frequent relief from toil and much of our toil has always been self-imposed. On the other hand, conditions that are too easy are not conducive to spiritual progress; for we are not yet far enough removed from the state of nature, under which we took origin, to react favorably in the absence of stimulation. The proposal to fill men's stomachs as a stimulus to their morals is worth considering, even though history and experience show that the hardest thing for man or nation to thrive upon is material prosperity. A fair degree of prosperity is indispensable, though excess may prove disastrous.

Now one of the things science has done is to establish our prosperity. In civilized lands, we can be sure of enough for the entire population to eat and of enough to wear. The problem is no longer how to produce the necessities of life so much as how to distribute them. In matters of production we are far ahead of our power to effect a just distribution. The socialists are right in their contention, that if we would deal fairly in distribution no man would be obliged to work more than four or five hours a day and that each could devote the remaining time to his spiritual interests, that under such a system many of our social problems would disappear. Our first claim for science, as having spiritual value, is, therefore, its establishment of the material foundations upon which spiritual advancement rests. While this value should not be minimized, since it lies at the basis of civilized life, it is easy to cite other values not so immediately allied to things material.

2. SCIENCE AND IMAGINATION

We often hear it said that, since science has destroyed the mystery of the universe, nothing remains for imagination. This statement has, I think, no basis in fact, and

[2] Wells, H. G., "This Misery of Boots," Ball Publishing Co., Boston, 1908.

arises from the failure to appreciate what science has done. Instead of restricting our imagination science has so enlarged our horizon that we may take a bolder flight. To the mind of primitive man and to the savage who survives in this state until our own times, nature appeared a thing of caprice rather than of order. The world was one of spirits, good or evil, who must always be considered, with whom man must make his peace. The day as well as the night was peopled with beings who ruled in the absence of any definite sequence of events and safety could be found only by submission to their caprice or propitiation of it. Under these conditions imagination had full play. But who in our generation would choose this brand of imagination? When man first observed the changeless motion of the stars "without haste, without rest," and gained an inkling that the same orderly sequence might apply to all natural phenomena, the opportunity for imagination was not lost. It was placed on a higher plane. The inhabitants of Europe, who once imagined Hell or the "Islands of the Blest" to lie beyond the Atlantic, have lost many fields in which the imagination of medieval man found exercise; but what a vista has been opened. Consider the sweep of the evolutionary conception through time and space. Or consider man as the victor over nature, notwithstanding those laws which are inexorable for other living things. No other species is known to have spread itself so widely over the earth and to have so changed its environment to suit its needs. Herein lies the difference between man and the rest of the animal world. Wherever else an animal has been subjected to a new environment, the result has been death or the evolution of a new type suited to meet the changed conditions. But man has taken himself and his domesticated plants and animals into surroundings to which neither he nor they are properly adapted; and instead of paying the penalty inevitable in a state of nature, has survived and the creatures under his care have survived with him. Where nature would say "Die!" man has said, "I will live!"; and he has succeeded in this because he forces from his environment the readjustments necessary for his well-being. Not always is this possible. The path is not trod with ease, but it is being steadily pursued. In his essay entitled "Nature's Insurgent Son," Lankester[3] thus compares man to an insurgent gone so far in his rebellion that there is no return; for capitulation can mean only death. The rebel must continue on his course until the end is won, if he is to find safety. He can not now return to the dominion of nature, he must succeed by controlling his surroundings, and knowledge of how to do this is more vital to him than aught else.

Again, take the poetry in modern invention. For it is there in plenty when you know how to find it, as Kipling has done time and again, but nowhere better than in his verses on "The Deep-sea Cables."

The wrecks dissolve above us; their dust drops down from afar—
Down to the dark, to the utter dark, where the blind white sea-snakes are.
There is no sound, no echo of sound, in the deserts of the deep,
Or the great gray level plains of ooze where the shell-burred cables creep.
Here in the womb of the world—here on the tie-ribs of earth
Words, and the words of men, flicker and flutter and beat—
Warning, sorrow and gain, salutation and mirth—
For a Power troubles the Still that has neither voice nor feet.
They have wakened the timeless Things; they have killed their father Time;

[3] Lankester, E. R., "The Kingdom of Man," Holt and Co., 1907.

Joining hands in the gloom, a league from the last of the sun.
Hush! Men talk to-day o'er the waste of the ultimate slime,
And a new Word runs between: whispering, "Let us be one!"

Is there not food for imagination in the phenomenon of the wireless message? A few years ago I spent a summer at the Puget Sound Marine Station. On a hill behind us was a wireless establishment to which we sometimes tramped for a chat with the operators. One day we were told with pride they had just picked up a communication from Key West, the longest distance from which that station had ever received a message. We below the hill had known nothing of this. "Warning, sorrow and gain, salutation and mirth" had passed over our heads on the wings of the air, and the telling of their passage was a revelation of things in the universe of which man knoweth naught, but which are not unknowable. To my mind we have gained more with the advance of science than we have lost; and imagination need not go unfed, when out of the fog, the night and the distance, as though from another world, comes that which signals "Save our Ship," to listening ears a thousand miles away on sea and shore.

3. Science and Esthetic Appreciation

Esthetic appreciation may seem as distant from science as are the poles from one another. Yet if we analyze the case, our esthetic response becomes, when stripped of what is non-essential, an intellectual rather than a sensual pleasure. The "good, the beautiful and the true," as we see it, is largely that to which we are accustomed, whether it be a brand of perfume, a style in skirts or a scientific theory. Also its cost, as Professor Veblin[4] shows, is an influential factor. Personally, I hold to the faith that there are such things as the beautiful and the ugly, that it is not all a matter of that to which one is accustomed, only I often doubt whether any of us know what's what. Within the purely intellectual realm, however, we are on safer since more common ground. For example, the satisfaction one has in the demonstrated theorem or in the chain of evidence when the last link is forged, is an esthetic satisfaction. There is the same feeling of completeness as in beholding the creation of artist or sculptor from which nothing could be taken away or nothing added without marring its perfection. Say that we appreciate such things merely because our minds run in certain channels. The fact remains that our minds so run, and that as long as human minds continue to be what they are we may expect them to follow similar courses. Stories are told of great minds completing their scientific discoveries in a state bordering on religious exhaltation, but many of us have felt the same thrill even though the work were not our own. The writer remembers how when a student he was taken by the "Mosquito-malaria Theory," as it was then called; and at a later date the esthetic appreciation with which he contemplated the apparent explanation of Mendelian segregation and of the determination of sex in terms of the behavior of chromosomes. In spite of uncertainties and the need for further investigation, one felt himself gazing at a picture near enough completion to show what it might become—a sequence so wonderfully ordered as to call forth an esthetic fervor. To many of us, therefore, scientific thinking and the contemplation of the theories of science present an esthetic appeal of the first order.

[4] Veblin, T., "The Theory of the Leisure Class," Macmillan Co., 1912.

4. SCIENCE AND FAIR JUDGMENT

A further aspect of science, having spiritual value, is the habit of fairmindedness induced by scientific reasoning. If scientific thinking is but a way of looking at things, the essential element of which is the formation of impersonal judgments—the reasoning in a way to reduce the personal equation to a minimum; if in this respect alone does the knowledge of science differ from that of everyday life, science may perform an important service by helping us to impersonal judgments in other lines.

To illustrate concretely, a teacher of theological students, desirous of imparting information regarding the origin of man, might find an effective approach through geology. There is little to arouse prejudice in the study of weathering, erosion, deposition and glaciation. When, however, these lessons have been learned, with their inevitable inference regarding the lapse of time, one finds an easy passage to the problems of organic evolution and thence to the question of man's origin. The same methods of reasoning are used throughout; only, in the last case, there is much to excite prejudice and this prejudice might be aroused by attacking the problem of man without preliminaries. So great is the similarity in the scientific method, wherever used, that the viewpoint obtained in an impersonal subject like geography, astronomy, or geology can be taken over bodily to allied fields. And the interpretation of phenomena remote from personal interest induces a dispassionateness which is a good point of departure for a journey into debatable territory.

The whole theory of evolution may be cited in further illustration. If this be presented as an interpretation of the facts of nature, to be accepted or rejected on the same basis as one would the earth's sphericity or the Copernican theory of the solar system, it is easy to show that the cases are parallel, when viewed impersonally and as scientific problems. Once into the subject, one passes insensibly to the problems of society, which are at bottom evolutionary problems. Poverty and crime, eugenics and euthenics, the organization of the state, and the rights of the individual are debatable in no such simple terms as comparative anatomy and embryology, paleontology or ecology; and because of this are subjects for prejudiced controversy rather than open-minded discussion. Take the case of poverty. How can a man with the scientific temper regard this as a question to be decided wholly in terms of the convenience or profit of landlord or employer of labor? The biologist might be influenced by his preconceptions of heredity and environment, but in so far as he shut his eyes to the evidence and failed to consider all the factors involved, he would be false to his scientific spirit.

Human beings suffer much from emotionalism in public matters. We shall doubtless continue to be guided by our hearts rather than our heads, but it is to be hoped we may come to use better judgment. In public affairs, it is particularly important that we think things out. At the beginning of all clear thinking in these matters are the facts of science, and the method of science is needed at every turn. If the question is upon religious revivals of the old-fashioned sort, we need to know, with such degree of scientific accuracy as is possible, the history of these movements in the past, and their psychological aspects in the present, before we can determine relative values. Now that democracy is spreading, we need, as never before, to correlate facts and weigh evidence in the dispassionate manner which is the ideal of

science. It is of little value to love truth and justice, if our ignorance makes it impossible for us to understand what is truth or how to do justice in a given instance. Truth may be relative and justice approximate, but we could do a far better job of it by making intelligent use of the facts we have.

Many of us believe that science has done more to help the cause of truth and justice in society than has any other line of human endeavor; for science has taught man the sequence of events to which he must conform if the individual or the nation is to reach its highest development. Because of scientific teaching, men demand to-day reasons for conduct other than traditional prohibitions or indulgences. And these reasons must be based upon scientific facts and presented in terms of scientific method. Science furnishes the groundwork to which our ethical judgment must conform. The old, emotional forms of thought play a losing game. Sentimentality is losing its grip in favor of a calm, farsighted determination to know what is true that we may do what is right, which is the highest ethical ideal. Science does not furnish the incentive to truth and justice, but it does furnish the material out of which truth and justice may be constructed by use of the scientific method; and for the individual, it furnishes the data needed for a well-ordered life.

> If you can keep your head when all about you
> Are losing theirs and blaming it on you;
> If you can trust yourself when all men doubt you,
> But make allowance for their doubting too:

Here again, Kipling states our case; for he presents the ideal of striving for truth and justice, not blindly but with a view to the whole situation.

We contend that the scientific method furnishes the only safe approach in our attack upon the complex problems of human life; since it enables us to approach these problems in a saner fashion, making for dispassionate judgment and for the elimination of prejudice. Now this elimination of what influences the "you" and the "me," in favor of what can be agreed upon as a fair interpretation by us all, is no easy matter. Scientific men do not always live up to their ideals within their own domain nor do they always carry over their ideals to daily life. But this impersonal way of thinking is a priceless possession, and if scientific men strive to apply it in life generally the effort is worth while however short it falls. We need more facts of science for our material progress, but more than this we need the method of science for the penetration of sham and for the elimination of personal interest in our dealings. The plea is not that the scientist is always a good citizen, but that the scientific method is useful for the citizen; that, as social life becomes more complex, it is necessary for the citizen to apply this method as a tool wherewith to shape the conclusions which shall guide his conduct.

5. SCIENCE AND EMANCIPATION

Finally, the value of science inclusive of every other is its influence upon our mental outlook; for only by the acquisition of a scientific habit of mind do we find intellectual emancipation. In substantiation of such a claim, we may cite the theory of organic evolution, which is the most comprehensive illustration afforded by the biological sciences, and perhaps by science generally.

The evolutionary concepts current among the Greeks were tinctured with philosophy. Lacking concreteness, they made little headway; and we find the beginnings of modern evolutionary doctrine in the accumulation of facts regarding animals and

plants which marked the centuries just preceding the year 1750. To Buffon and to other less known writers of the eighteenth century belongs the credit for having first promulgated the evolutionary theory in a form which was scientific rather than philosophical and which carried a measure of conviction, despite its crudities and the hampering of theological criticism. One can not turn the pages of Buffon's encyclopedic work without a growing respect for the knowledge of animal life there represented. Obviously, the foundation for much of our comparative anatomy of vertebrates was even then established. It is a familiar story how Lamarck was the first to offer a theory of the causes of evolution; how he failed to make his case as against the authority of Cuvier; how the latter, although opposing evolution, accumulated some of our strongest evidence, through his studies in comparative anatomy; and how von Baer supplemented this by his work in embryology; until in Darwin's day there were ample facts at hand for the establishment of the fact of evolution, if not for the determination of its causation.

As Professor Lovejoy[6] has pointed out, evolution itself aside from its causes might have been accepted, as the only reasonable interpretation of the facts, at any time after the year 1840. That it was not so accepted among those who ridiculed the "Vestiges of Creation," is a sad comment upon the open-mindedness of science and the psychology of conviction in its relation to evidence. The story that science hesitated for lack of evidence, only adduced by the "Origin of Species," does not represent the facts. Though we have inherited this tradition from so clear a thinker as Huxley, we should be anxious to replace it with a frank avowal, that the two decades following 1840 present a humiliating spectacle to workers who pride themselves upon the acceptance of doctrines whenever and wherever the evidence is forthcoming. The fact is that during the period in question science may well be accused of shutting its eyes to patent evidence. Darwin's claim to distinction lies in his early recognition of the evolutionary problem as at the core of biological science, and in his marshalling of facts for evolution and for his theory of "Natural Selection" in a manner that was overwhelming. The almost immediate acceptance, in biological science, of Darwin's views and the spread of the evolutionary concept to other fields during the remaining years of the nineteenth century are well known. Evolution has won its fight. We are here concerned with its effects upon human thinking in the past and its probable influences in the future.

The triumph of the evolutionary conception completed the overthrow of those older ideas of the universe which culminated in medieval theology. Evolution was the final extension of that enlarging horizon disclosed by the theory of the earth's sphericity and the Copernican theory of the solar system, concepts which are indissolubly united and which represent each a stride forward in the face of diminishing resistance. It went hard with Galileo, and so would it have gone with Copernicus had all the implications of his theory been recognized before his death. Buffon was not in physical danger, though forced to recant. Darwin, though heaped with abuse, suffered not even inconvenience at the hands of his critics. During the three centuries involved, man's picture of himself

[6] Lovejoy, A. O., "The Argument for Organic Evolution before 'The Origin of Species,'" *Popular Science Monthly*, November and December, 1909.

changed from that of a being, recently created and awaiting a day of judgment in the not distant future, to that of a being originating as part of organic nature and set in a universe without beginning and without end. The by-product of this intellectual revolution was an emancipation of the human spirit from the bonds of authority. Authority indeed remained, but no longer that of book or pope. In its place came the authority of nature; and so great was the change we have not yet recognized its full significance.

While we can the better visualize the effects of evolutionary doctrine by thus going back several centuries, it is equally important to recognize what is happening to-day, how this doctrine has affected theological belief since the year 1859, what has happened in philosophy, and what changes have occurred in our outlook upon the problems of society.

In theology, the evolutionary doctrine is carrying us from the concept of a single religion, revealed to man by agents duly inspired, to a multitude of religions of varying worthiness, but all the outgrowth of yearnings which originated with human intelligence. We need not condone the shortcomings of the fathers nor strive for theological explanations of sin and death, of sorrow and pain since these are the not unnatural incidents of our evolution. We know in part whence we came, if not whither we are going, and it is enough if we may by our own efforts somewhat improve the material and spiritual state of ourselves and our children. This new viewpoint has been reached not by a sudden break with the past, but by a gradual shift of mental attitude which makes the older doctrines impossible of acceptance. We have applied the evolutionary concept to religion, as to every other expression of organic nature; and the result has been a revolution, accomplished before its beginnings were recognized. Thus science has brought emancipation from theological bondage and set free the spirit of man for higher flights in the future.

In philosophy, the evolutionary theory has necessitated the change from a static to a dynamic universe, as witness the contrast between the philosophical systems of the early nineteenth century and the views of Bergson. This change has not yet completed its remodeling of philosophical theories, but only a philosopher can explain its workings.

In the field of social phenomena, we see the influence of the evolutionary theory through the recurrent questioning of the necessity for existing conditions. If the revolutions of the eighteenth century attacked the foundations of civic power and sought to install the authority of peoples over that of kings, the revolution induced by the evolutionary theory has shaken the whole edifice of social tradition. Whatever *is* may be the natural outcome of the evolution of society to date, but it is not thereby right nor is it necessarily permanent. We may, as evolutionists, recognize the stability of social customs, which have arisen by evolution; but we also recognize these customs as subject to change. Moreover, we must consider the intelligent direction of our future evolution as a possibility, however remote. Evolution has not always taken the most desirable course, as witness the degeneration incident to parasitism; and while we shall probably have little to do with its outcome in the human species, what we may do is worth considering. Germany has evolved a social organization threatening the ideals which dominate the majority of western nations, in challenging which we are striving to direct

the course of social evolution. If we succeed, individualism working collectively will triumph over medieval collectivism.

The influence of the evolutionary conception may be seen again in our attitude toward social problems such as disease and crime. These are not inevitable conditions to be treated by curative measures only. They are to be attacked with all the knowledge of hereditary and environmental factors we can command, and finally eliminated by the evolution of a type of man and a form of society in which such excrescences will be non-existent. We are no longer content with our lot, merely because things have been as they are within the memory of man or because we see no prospect of immediate change. Things have changed in the past and we want to change them in the future. We are not content to let evolution take its course with us, we want to make it go our way. Thus the insight into social changes which evolution brought has given a habit of mind that will brook no restriction upon the human spirit. As with philosophy, we have the change incident to an outlook upon a dynamic as opposed to a static world.

In conclusion, we have shown that science feeds the spiritual as well as the material man. Science deals with what we can measure and weigh, is wholly impersonal, is a thing of the intellect rather than of the emotions. But the intellect and the emotions are not separate entities of the mind, rather the mind is a unit which has its intellectual and its emotional sides. The raw material of scientific fact is susceptible of unlimited organization within the mind and this process of organization gives play to our spiritual nature. If we have made our point, the progress of science has given the spirit of man far more than it has taken away.

WINTERTON C. CURTIS

UNIVERSITY OF MISSOURI

MEASURES FOR PROTECTING WHEAT-FLOUR SUBSTITUTES FROM INSECTS

READERS of SCIENCE may be interested in work being done to prevent the loss of wheat-flour substitutes due to insect attack. Many of the millers and dealers who handle the cereals which the Food Administration is now requiring as substitutes for wheat flour have always recognized them as being subject to insect attack to such a degree that it has been considered poor policy to handle them extensively during the summer months.

The amount of embryo which is included in a flour, and the coarseness of the product are usually taken as an index of susceptibility to insect attack, coarse flours with the most embryo being the most susceptible. The wheat-flour substitutes and other cereals contain embryo, are relatively coarse, and are known to be highly susceptible to insect attack.

Millers, dealers and consumers, will handle more of the susceptible cereals than usual this summer and, unless unusual care is taken to protect them, the requirement of the Food Administration may result in an increased loss of food and thus defeat the object of the government. However, such losses can be prevented and, if proper precautions are taken, the handling of wheat-flour substitutes need not lead to serious complications with insect pests. The division of entomology and economic zoology in cooperation with the department of animal biology at the University of Minnesota, and the Minnesota State Food Administration have been outlining recommendations and methods for aiding the millers, dealers and consumers of Minnesota in preventing losses of wheat-flour substitutes. The measures are preventive and it is proposed to cover the state with propaganda before any serious trouble has arisen.

The millers are probably the best prepared for the new conditions. The operators of the large flour mills in Minneapolis have learned from experience that these cereals must be carefully handled and they were the first to anticipate complications arising from the war-time emergency. The cereals which are put upon the market in sacks are not permitted to remain in storage but are hastened to the con-

sumer, if possible, in less time than is required for the development of the insects beyond the egg stage.

The cereals which go out in sealed packages are heated to about 85° C. at the time of packing. This temperature will kill all stages of insects and if the packages are tightly sealed such products are practically free from insects' attack, unless they are stored in badly infested places. When the insects have access to packages, they will enter through any cracks which they may find and in cases of bad infestation they will make holes through the wrappers and boxes. To protect themselves against losses while these cereals are in the possession of retail dealers, many of the large milling concerns are turning the cereals over to the dealers with only a "sound on delivery" agreement.

It is with the retail dealers and the consumers that this work is particularly concerned. With the millers protecting themselves by rapid transit and the "sound on delivery" agreement the liability of loss devolves upon the retail dealers and the consumers. The retail dealers and consumers must protect themselves against the introduction of undeveloped insects in the cereals. In many of the retail stores where proper precautions are not taken the insects are present and ready to infest the sacked cereal and even that in sealed packages may be destroyed or infested with eggs. Cereals not destroyed in the store may contain eggs which either did not hatch during the short period after leaving the mill or were deposited while in the infested store. The result is that the homes are very apt to become infested. Dealers are recommended to adopt the miller's policy of rapid handling of cereals and to take proper precautions in the sanitation of their stores. Instructions are being sent out to the dealers emphasizing the responsibility resting on those who handle wheat-flour substitutes and warning them of the serious losses which may result if they permit the cereals to be exposed to insect attack.

Consumers are instructed to buy small quantities of cereal, to avoid "sealed package" cereals when the packages are broken or contain holes, to heat "sacked cereals" just as soon as they are taken home, and to use great care in storing all wheat-flour substitutes. If the millers and dealers are able to eliminate their loss by the rapid handling of cereals the loss which our country will experience will depend upon what the consumer does to eliminate loss after the cereal reaches him.

The heating of the cereal to kill any stages of insects which it may contain will protect the consumer against the infestation of the home and in addition it will reduce to the minimum the loss caused by cereal insects. A method of heating cereals in the oven has been simplified and standardized as a result of a series of experiments on heat conduction in cereals and fatal temperatures of the insects infesting them.

The problem in heating is to obtain a condition in which the minimum temperature in any part of the cereal is well above the fatal temperature of the insects, about 45° C. at 24 per cent. of relative humidity. At the same time the temperature in the hottest part must be kept well below the heat which will injure the cereal. about 94° C. This can be done by placing the cereal in pans about two inches deep and heating it in the oven until the surface of the cereal reaches 85° C. At this point the fire should be turned out, in the case of gas, gasolene, or kerosene ovens, and the cereal should be left in the closed oven for forty-five minutes. If a coal or wood stove is used, the oven door should be opened when the top of the cereal reaches 85° C. and the fire should be kept low during the forty-five minutes. Temperature curves representing the temperature of the top, center and bottom of such a pan of cereal show that the center of the cereal reaches a temperature between 55° and 60° C. and that it remains above the fatal temperature for insects for about half an hour.

Since thermometers which indicate high temperatures are not in reach of all housewives, a wax has been standardized to melt between 82° and 85° C. and is to be manufactured under the direction of the Food Ad-

ministration. The wax is furnished in small pieces packed in boxes which will cost the consumer five cents for a season's supply and is to be distributed to the retail dealers through the jobbers. The directions are very simple and explicit, for one has only to place some wax upon a piece of paper on top of the cereal and heat until the piece of wax melts to a grease spot which will be 85° C. Then it is recommended that the cereal be mixed and left in the oven for forty-five minutes as stated above.

Warnings with regard to the proper storage of the cereal after it has been heated make it clear that the cereal will remain free from insects only when stored where no insects can get at it.

The cereals used in the heating experiments have been submitted to various cooking processes by the department of domestic science at the University of Minnesota and no injury was apparent even when the cereals were heated to a temperature of 95° C.

This work has been undertaken in anticipation of a condition which seems very certain to develop. With the cooperation of the millers in "sterilizing" and rapidly handling the cereals, of the dealers in increased sanitation and in furnishing consumers with "heat-testing wax," and finally of the consumer in heating the cereal when it reaches him, it is hoped that our country may be aided in its effort to conserve the food needed to win this war. Similar campaigns in other states might aid in reducing a loss which seems inevitable if no unusual measures are taken.

ROYAL N. CHAPMAN

THE UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, MINN.

SCIENTIFIC EVENTS

THE PROGRESS OF BIRTH AND DEATH REGISTRATION IN THE UNITED STATES

THE recent inclusion of Hawaii has extended beyond the limits of Continental United States the area for which the Census Bureau annually collects and publishes death statistics. Within this area now reside about 78 per cent. of the total population of Continental United States and Hawaii. It comprises, in all, 27 states, 43 cities in other states, the District of Columbia and the territory of Hawaii. East of the Mississippi the only states not included are Alabama, Delaware, Florida, Georgia, Illinois, Mississippi and West Virginia, while west of the Mississippi the only states included are California, Colorado, Kansas, Minnesota, Missouri, Montana, Utah and Washington.

The annual collection of death statistics from states and cities maintaining adequate registration systems was begun by the Census Bureau in 1902, the first report covering the calendar years 1900 to 1904, inclusive, and for each succeeding year a separate report has been published. The original registration area contained 40 per cent. of the total population of the country. It remained unchanged until 1906, since which year it has shown an almost uninterrupted increase in geographical extent and in proportion of total population, until at present it contains nearly three fourths of the country's inhabitants.

In birth registration highly satisfactory progress has been made during the past two years, although there are still a number of states in which adequate death registration prevails but in which the registration of births has not yet reached a sufficiently close approximation to completeness to justify the acceptance of the local records by the Census Bureau. The birth-registration area, as at present constituted, comprises 19 states—the six New England states, New York, Pennsylvania, Maryland, Virginia, North Carolina, Kentucky, Ohio, Indiana, Michigan, Wisconsin, Minnesota, Utah and Washington—and the District of Columbia. This area is estimated to contain about 51 per cent. of the total population of the country, as against about 31 per cent. when the collection of birth statistics was begun, a little more than two years ago, from an area comprising the six New England states, New York, Pennsylvania, Michigan, Minnesota and the District of Columbia.

This growth, in so short a time, is gratifying. It is, however, unfortunate that in the United States the registration of vital phe-

nomena has thus far depended, first, upon adequate state or municipal legislation, and, second, upon the adequate enforcement of that legislation. As a result, some states and municipalities maintain efficient registration systems while others do not. Until the matter is placed under federal control or supervision it is not likely that reliable birth and death records, approximating completeness, will come into existence throughout the entire United States. Since the military registration of June 5, 1917, the desirability of maintaining such records has become apparent to all.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE

SIR HENRY E. ARMSTRONG, chairman of the executive committee of the International Council of the Central Bureau of the International Catalogue, writes in *Nature:*

The Conjoint Board of Scientific Societies, some time last year, appointed—by what mandate is not clear—an International Catalogue Subcommittee "to obtain information regarding the extent of the use made by scientific men of the present International Catalogue of Scientific Literature, and to obtain recommendations for possible improvement." The subcommittee consisted of Dr. Chalmers Mitchell, Mr. C. V. Boys and Mr. E. B. Knobel, in addition to the official members. The subcommittee appears to have gone outside the terms of reference and to have reported "that it was advisable to consider suggestions for an alternative scheme." . . .

The history of the International Catalogue is briefly as follows. In 1893 the Royal Society was memorialized to take into consideration the preparation of complete author and subject catalogues, by international cooperation, in continuation of the society's Catalogue of Scientific Papers, which the society did not propose to continue beyond the century. The proposal being viewed with favor, the Royal Society solicited the opinion of scientific workers all over the world. There was practically but one reply—that such catalogues were essential, and almost universal agreement that the only way of carrying the work into execution was by international cooperation. Representative committees were appointed, and after two years of very hard work a scheme was prepared which was forwarded abroad, together with the invitation to attend the first international conference on the subject. This was held in July, 1896. Two subsequent international conferences were held in London in October, 1898, and June, 1900. All three were highly representative. Ultimately it was decided, at the third conference, to establish the catalogue as an international enterprise. Work was begun in 1901, and has been continued up to the present time. The organization has grown steadily in weight and efficiency, and at the beginning of the war there were thirty-four regional bureaus in operation. The harmony which has prevailed throughout among the nations is one of the most remarkable features of the enterprise; notwithstanding the complexity of the work, there has not been the slightest friction. I believe no other international enterprise of like magnitude has been called into existence or worked more smoothly. . . .

As war went on, it became necessary for the society to evaluate its responsibilities towards the catalogue. It was decided that the society could not guarantee the publication of the catalogue beyond the fourteenth issue. An issue consists of seventeen volumes, each dealing with a separate science. The fourteenth issue is now being published, and it is noteworthy that special contributions in aid of publication have been made by the Carnegie Foundation of New York, by the Department of Scientific and Industrial Research, and by certain private donors.

The Royal Society has also undertaken the direct control of the enterprise during the period of the war. Early last year it was intimated to workers abroad that the future of the catalogue must be left for the decision of an international council to be called as soon as possible after the conclusion of peace.

Why the Conjoint Board has intervened is not clear. It certainly has no right to give the catalogue its quietus. That it should have taken the action it has *without ever consulting the international organisation* passes belief.

I attended the meeting of the board on Wednesday last, and protested most strongly against the discourtesy the subcommittee has displayed towards our Allies and the neutral countries concerned in the enterprise.

It is unnecessary to dwell on the special need at the present time of maintaining and cementing relationships that have been so happily established, and to comment further on the unhappy policy adumbrated by the subcommittee.

PRIZES OFFERED BY THE AMERICAN FISHERIES SOCIETY

IT is announced in the *Fisheries Service Bulletin* that in order to develop interest in fish culture and related subjects, and to stimulate expression regarding them, the American Fisheries Society has, through its president and executive committee, decided to offer three prizes of $100 each to be awarded at its meeting in New York state in September, 1918, as follows:

1. For the best contribution on fish culture; either new or improved practical fish-cultural appliances, or a description of methods employed in the advancement of fish-cultural work.

2. For the best contribution on biological investigations applied to fish-cultural problems.

3. For the best contribution dealing with the problems of the commercial fisheries.

A committee of three members of the society, one a practical fish-culturist, one a scientist, and one a practical commercial fisherman, to be appointed by the president, will pass upon the material submitted. The conditions governing the competition are as follows:

1. Any person who is a member of the society, or who duly qualifies as a member prior to September 1, 1918, may compete for the awards.

2. Each competitor is to notify the secretary of the society, John T. Titcomb, state fish-culturist, Albany, N. Y., before September 1 of the particular prize for which he intends to compete.

3. Each paper or exhibit offered in competition is to be in the custody of the secretary of the society on or before September 3, 1918.

4. Each device, apparatus, process, or method offered for an award is to be presented by a sample, model, or illustrated description, each to be accompanied by a complete statement of the points for which an award is asked.

The society is to reserve the right to publish any papers or photographs submitted in competition prior to their publication elsewhere; provided, however, that in the event of failure to publish within nine months after the meeting the author will be at liberty to publish when and where he may elect.

5. The committee appointed by the president is to determine the competitors who are entitled to awards, and the decision of the committee is to be final.

6. In order to obtain additional information if desired the committee may call before it persons who may have entered the competition, and also other persons.

7. The committee is to make its final report to the society not later than the morning session of the third day of the meeting.

THE MEDALS OF THE GEOLOGICAL SOCIETY OF LONDON

AT the anual meeting of the society on February 15, the president, Dr. Alfred Harker, handed the Wollaston Medal, awarded to Dr. Charles Doolittle Walcott, to Mr. William H. Buckler, attaché to the Embassy of the United States of America in London for transmission to the recipient, addressing him as follows:

> The Wollaston Medal, the highest honor at the disposal of this society, is conferred upon Dr. Charles Doolittle Walcott in recognition of his eminent services to geology and paleontology, more particularly among the older fossiliferous rocks of North America. While his administrative work, both on the United States Geological Survey and at the Smithsonian Institution, has done much for science in his own country, his personal researches have excited interest and admiration wherever geology is cultivated.
>
> He has made important contributions to the history of the Algonkian formations, and his discoveries lead us to hope that the less altered of those ancient sediments may ultimately yield more abundant and definite relics of pre-Cambrian life.

His detection of fish remains in the Ordovician rocks of Colorado, again, carried back by a stage the earliest appearance of vertebrates in the succession of life forms. But it is in the Cambrian strata that Dr. Walcott has found chief scope for his labors, which, pursued principally upon the American continent, have often had a world-wide importance. Realizing the dual part which the exponent of paleontology is called upon to sustain, he has illuminated that science alike in its geological and in its biological aspect. Under the former head should be mentioned the determination and collation of the stratigraphical sequence in numerous districts, and the light thrown thereby upon the problems of paleophysiography. In particular, Dr. Walcott's study of the geographical distribution of the Cambrian faunas, establishing the existence of two distinct provinces, marked a signal advance in this field. On the biological side his work has been no less fruitful in results. It is sufficient to recall the series of memoirs dealing with the Trilobites, in which he greatly elucidated the organization of that important group, and again his two handsome volumes on the Cambrian Brachiopoda.

In recent years, with energy which a younger man might envy, he has pushed his researches into the Rocky Mountains of Canada, amidst scenery which his beautiful photographs have made known to many. There he has been rewarded by the bringing to light of two richly fossiliferous horizons in the Middle Cambrian succession, including in one an assemblage of fossils marvelous for the perfect preservation of their detailed structure. The preliminary account of the discovery has aroused keen interest, and paleontologists eagerly await the full description by a master hand of this unique collection.

If by his official status, joined with his personal record, Dr. Walcott is in some sense representative of American geology, with its large opportunities so ardently embraced, the occasion may remind us that community of scientific interests is perhaps not least among the links which unite your country to ours. I have much pleasure, Sir, in placing this medal in your hands for transmission to its recipient, and trust that his future career may include achievements no less brilliant than those which we commemorate to-day.

In handing the Murchison Medal, awarded to Joseph B. Tyrrell, to the Hon. Sir George Halsey Perley, high commissioner for the Dominion of Canada, for transmission to the recipient, the president addressed him as follows:

The Murchison Medal has been awarded to Mr. Joseph B. Tyrrell in recognition of the value of his many services to geological science. In the breadth of their scope, in the pioneer element which has so largely entered, in the practical benefits which have often followed, those services may stand as typical of Canada's contribution to geology.

During more than thirty years Mr. Tyrrell has been frequently engaged in exploiting wide tracts of the little-known Barren Lands of northern Canada, making prolonged journeys of a kind which demands no ordinary resolution and endurance. Besides thus adding largely to geographical knowledge by his own efforts, he has done much to make known the results of earlier explorers in the north. While helping very materially to develop the mineral resources of the Dominion, he has at the same time gathered much valuable information touching the older rocks of the region; and, uniting in his own person the geologist and the prospector, he has often shown by example how science and enterprise may go hand in hand, to the great advantage of both.

On the side of pure science, however, his most notable researches have been in the domain of glacial geology, where his extensive acquaintance with the country has enabled him to arrive at conclusions of a large order. Prior to 1894 it was generally held that the ice which once overspread Canada, east of the Cordillera with its mountain glaciers, emanated from a single center of dispersal. Mr. Tyrrell first demonstrated the existence and approximate limits of a great ice sheet, which he named the Keewatin, centering in the country west of Hudson Bay and distinct in origin from the Labradorean ice sheet on the east. To these two he subsequently added a third, under the name of the Patrician Glacier, which had its gathering-ground to the south of Hudson Bay. His development of this thesis, involving a discussion of the relations in time and space of the ice sheets radiating from different centers, must rank among the most important contributions to the glacial history of North America.

In forwarding to Mr. Tyrrell this token of recognition from the council of the Geological Society, I beg, Sir, that you will add to our congratulations upon what he has already accomplished our hope that many years of activity still remain to him; and this wish will, I am sure, be echoed by his numerous friends on both sides of the Atlantic.

SCIENTIFIC NOTES AND NEWS

A BOARD of medical officers, consisting of Colonels Deane C. Howard, M.C., U. S. Army; Frederick F. Russell, M.C., U. S. Army; Victor C. Vaughan, M.C., N. A.; Lieutenant-Colonel William H. Welch, M.C., N. A., and Contract Surgeon Rufus Cole, has been appointed for the purpose of making an investigation as to the nature, causes and prevention and treatment of pneumonia, and its complications, in the various military camps in the United States. It will report from time to time to the surgeon-general of the army, to whom a full report will be made as soon as practicable after the completion of the investigation.

MAJOR A. J. CARLSON, S.C. N. A., attached to the Food Division or the Surgeon-General's Office, is at present on duty in England making a study of food conditions in the rest camps of the United States Army.

MAJOR SAMUEL C. PRESCOTT, S.C., N. A., attached to the Food Division of the Surgeon-General's Office, has just returned from a tour of southern camps in which he was making an inspection of the conditions of storage as affecting the healthfulness of foods supplied to troops in training.

THE following named officers of the Food Division, Surgeon General's Office, are on duty in France: Major Philip A. Shaffer, Captains Walter H. Eddy, Arthur W. S. Thomas, F. B. Kingsbury and M. G. Mastin, all S.C., N. A.

DR. GEORGE E. VINCENT, president of the Rockefeller Foundation, who had been on a trip of nearly three months to Italy, France and England, arrived in New York on June 1, accompanied by Dr. Livingston Farrand, president of the University of Colorado, who had been in charge of the foundation's tuberculosis work in France for a year.

THE close of the present year at Western Reserve University will be marked by the retirement of Professor F. P. Whitman, who has held the chair of physics and astronomy at Adelbert College for thirty-two years. Professor Whitman, who was born in Troy, New York, was graduated at Brown University in 1874.

SWARTHMORE COLLEGE at its commencement, on May 20, bestowed the honorary degree of doctor of letters upon Provost Edgar F. Smith.

AT its recent commencement Syracuse University conferred the honorary degree of doctor of science on Professor Albert Perry Brigham, of Colgate University.

THE University of Pittsburgh has conferred its doctorate of science on Raymond Foss Bacon, director of Mellon Institute, University of Pittsburgh, and lieutenant-colonel in charge of the chemical work of the American forces in France, and on George Coffin Johnston, professor of roentgenology in the University of Pittsburgh, and major in the medical corps, the doctorate of engineering, on Walter Victor Turner, pneumatic expert with the Westinghouse interests, and the doctorate of chemistry on Arthur Dehon Little of Boston.

IN recognition of his distinguished work at Yale University, Joseph Barrell, '00, Ph.D., professor of structural geology, has been elected to honorary membership in the Phi Beta Kappa Society.

DR. J. BISHOP TINGLE, professor of chemistry at McMaster University, Toronto, has been elected a fellow of the Royal Society of Canada.

SIR THOMAS R. FRASER, who succeeded Sir Robert Christison as professor of materia medica in the University of Edinburgh in 1877, has tendered his resignation, to take effect at the end of the present year.

DR. R. S. HEATH, professor of mathematics at Birmingham University, vice-principal and registrar, has announced his intention to retire owing to ill-health.

THE War Industries Board has created a commodity section on medicines and medical supplies, with Lieutenant Colonel F. F. Simpson as its chief.

DR. THOMAS L. WATSON, professor of geology in the University of Virginia and state geologist of Virginia, has been engaged for

some months in cooperative state and federal work on war minerals and materials in Virginia. He is a member of the subcommittee of the National Research Council on materials for rapid highway and railroad construction behind the front, and an associate member of the war minerals committee.

Mr. W. S. Fields has resigned as assistant plant pathologist in the Arkansas Experiment Station to take up work as extension plant pathologist under the Bureau of Plant Industry, with headquarters in Mississippi.

The Bureau of Fisheries has engaged Professor J. Percy Moore, of the University of Pennsylvania, for investigation of fishes and other aquatic animals in relation to mosquito control in northern regions. For the present, at least, his investigation will be conducted in the general vicinity of Philadelphia.

The following men have been called for military service from the botanical department of the Michigan Agricultural College: Mr. C. F. Murphy and Mr. C. W. Bennett, graduate assistants in botany, and Mr. Ray Nelson, research assistant in plant pathology.

The geologists of the Ohio Academy of Science for their spring meeting made an excursion to the southern part of the state. The party, twelve in number, left Columbus at noon on May 31 and returned late on June 2. The Silurian formations of Highland county were visited under the lead of A. F. Foerste, and the Mississippian and Pennsylvania of Pike and Jackson counties under the lead of J. E. Hyde and Wilber Stout. Stops were made at the Serpent Mound in Adams county and at Camp Sherman.

Four curators of the Museum of the University of Pennsylvania are now in the army, while two others are in Egypt excavating for the Eckley B. Coxe, Jr., Expedition and can not return until after the war. Dr. Stephen Langdon, curator of the Babylonian section, is in the British army and will remain there during the war. He is professor of Assyriology at Oxford University, but was given permission last year to come to this country and accept the post of curator on condition that he give one course of lectures a year in Oxford. Owing to raising the age limit he was not permitted to leave England this spring and is serving with the colors. Dr. William C. Farabee, who led the museum's Amazon Expedition for three years, has just been appointed a captain in the intelligence corps and will soon leave for service. Stephen B. Luce, of the Mediterranean Section, has been appointed a lieutenant in the Navy and is now in service. H. U. Hall, assistant curator of the American Section, is serving in France with the Keystone Division.

The Royal medals of the Royal Geographical Society, London, have been awarded by the council as follows: The founder's medal to Miss Gertrude Bell, for her important explorations and travels in Asia Minor, Syria, Arabia, and on the Euphrates; the patron's medal to Commandant Tilho, French Colonial Infantry, for his long-continued surveys and explorations in northern Africa. Owing to the shortage of gold the medals will, with the King's approval, be struck in bronze instead of gold, and the balance of their value be given in war bonds. The other awards are as follows: The Murchison grant to Mr. C. A. Reid, for his maps of the Belgian Congo, which he has placed at the disposal of the society; the Cuthbert Peek grant to Mr. G. F. Archer, for his surveys in East Africa connecting Major Gwynn's Abyssinian triangulation with the triangulation of East Africa; the Back grant to Captain Bartlett, for his distinguished leadership after the loss of the *Karluk;* the Gill memorial to Major Cuthbert Christy, R.A.M.C., for his surveys and explorations in central Africa.

Dr. William Townsend Porter, professor of physiology in the Harvard Medical School, will be the commencement speaker at Milton Academy on June 15.

Professor William S. Franklin, of the department of physics of the Massachusetts Institute of Technology, lectured before the Washington Academy of Sciences, on June 7, on "Some needed lines of research in meteorology."

DR. E. E. SOUTHARD, of the Harvard Medical School and the Massachusetts State Psychopathic Hospital, gave a lecture on May 14 at the University of Chicago on "War neuroses after the war."

THE Ramsay Memorial Fund, founded under the presidency of Mr. Asquith to raise £100,000 for Ramsay Memorial Fellowships in chemical science, and a laboratory of engineering chemistry at University College, London, has made considerable progress in recent months. Subscriptions and promises to date amount to £82,600. The latest donations include: M. Eugène Schneider, £500; Lady Durning Lawrence, £100 (second donation); Sir G. H. Kenrick, £100; Académie des Sciences de l'Institut de France (of which Sir William Ramsay was a corresponding member), £80; the Fertilizer Manufacturers' Association, £52 10 s.; his Highness the Maharaja Dhiraj of Patiala, £50. "Memorials of the Life and Work of Sir William Ramsay," by Sir William A. Tilden, will be published shortly by the Macmillans.

IN memory of Lieutenant William T. Fitzsimon, Kansas City, who was killed last September, when the German airplanes bombarded the Harvard University Hospital in France, the park commissioners of Kansas City have decided to erect a memorial in the form of a public drinking fountain which will bear an inscription relating the details of Dr. Fitzsimon's work and death.

CHARLES CHRISTOPHER TROWBRIDGE, assistant professor of physics in Columbia University, died suddenly on June 2, aged forty-eight years. Dr. Trowbridge was the author of researches on fluorescence and phosphorescene in gases and also on physical aspects of the flight and migration of birds.

DR. JOSEPH DENIKER, the distinguished French anthropologist, died on March 18, aged sixty-six years. Dr. Deniker, who was chief librarian of the Paris Natural History Museum, was born in Russia.

ALFRED GORDON SOLOMON, of London, known for his contributions to the chemistry of brewing, has died in his sixtieth year.

UNIVERSITY AND EDUCATIONAL NEWS

A GIFT of $400,000 to the Massachusetts Institute of Technology was announced by President Richard C. Maclaurin at a meeting of the corporation on June 7. The name of the donor was not made public. The income of the fund will be used for general purposes of the institute during the war and thereafter applied to the development of courses in chemistry and physics.

THE alliance between Columbia University and the Presbyterian Hospital, which was first made in 1911, and was planned to result in the establishment of a great medical center in New York City, has been cancelled by the managers of the hospital. Columbia University was unable to obtain the money needed for its share of the buildings and rejected the plans proposed as a condition of an endowment from the Rockefeller Foundation.

DR. JOHN T. FAIG, professor of mechanical engineering in the University of Cincinnati, has been appointed president of the Ohio Mechanics Institute, succeeding Professor John Shearer, who has been head of the institute for twenty years. Professor Faig is now taking charge of the college of engineering in the absence of Dean Herman Schneider, who is engaged in military service in Washington.

DR. F. OCARANZA, professor of physiology at the University of Mexico, has been appointed secretary of the faculty of medicine. He is at the same time secretary of the Academy of Medicine.

THOMAS J. MACKIE has been appointed professor of bacteriology in the South African Medical College, Cape Town.

DR. T. FRANKLIN SIBLY, of University College, Cardiff, has been appointed professor of geology at Armstrong College, Newcastle-upon-Tyne, in succession to the late Professor Lebour.

DISCUSSION AND CORRESPONDENCE

DESMOGNATHUS FUSCUS AGAIN

IN SCIENCE (N. S., Vol. 47, Apr. 19, 1918, pp. 390–391) Professor H. H. Wilder under the heading "*Desmognathus fuscus* [sic]" has

much to say about the grammatical sins of biologists in the use of systematic names. These I am not defending, nor is it my intention here to analyze the motives which induced the International Zoological Congress to refuse to sanction subsequent correction of such errors. But the case which serves him for a heading is of a different nature. He characterizes Spencer F. Baird's use of the combination *Desmognathus fuscus* as a "mistake" which "was followed by several illustrious men, both anatomists and systematists, among others by Wiedersheim (1887), W. K. Parker (1879), Boulenger (1882), and as late as 1909, by Gadow." I think it can be shown, however, that these illustrious men, as far as the grammar is concerned, were as correct as the other zoologists quoted by him, who wrote *Desmognathus fusca,* both forms being grammatically correct.

The rule governing the gender of Greek composite words is, as I understand it, that the unmutated composites follow the gender of the final component. Thus *dermatochelys* is feminine because *chelys* is feminine, *chelys* being Greek for turtle, and *dermatochelys* for a leather-back turtle.

Mutated composite words, on the other hand, except personal names, are of common gender, that is, they may be used either as masculines or feminines. Thus *kallithrix* as a zoological appellative may be used either as a masculine or as a feminine noun, notwithstanding the fact that *thrix,* hair, is feminine.

As an example of the above rule, let us examine a familiar word commonly used in forming zoological generic appellatives, for instance, *rhynchos,* a beak, a bill (*rhamphos* might just as well have been chosen). The gender of this Greek word is neuter. Now, were I to describe and classify beaks only, I might speak of a *goniorhynchos* and of an *orthorhynchos* according to whether the beak were angular or straight, and these composite words being unmutated would also remain neuters. But when I designate a fish or a bird as *Goniorhynchus* or *Orthorhynchus* meaning a fish with an angular beak or a bird with a straight bill, these appellatives assume the common gender and the specific adjectives may be masculine or feminine according to my choice. Thus it would be grammatically correct to say either *Goniorhynchus albus* or *Goniorhynchus alba,* but certainly NOT *Goniorhynchus album,* in spite of the fact that *rhynchos* is neuter.

Similarly, if one were to speak of a jaw as a *desmognathos,* its gender is undoubtedly feminine, *gnathos* being feminine, but naming, as Spencer F. Baird did, a salamander *Desmognathus* he created an appellative of the common gender and he was at perfect liberty to use the masculine form of the adjective *fuscus* in conjunction with it. He certainly committed no grammatical blunder "in all its shame." Equally correct was Dr. J. P. Moore when he instituted the genus *Leurognathus* for another salamander and named the species *Leurognathus marmorata.*[1]

It will thus be seen that Baird and those who follow him have not "changed the grammatical gender of the noun *gnathos,*" but have simply availed themselves of their right to select from the common gender of the salamander *Desmognathus* that which in their opinion was most consistent with general zoological practise. This, it is interesting to note, has been to regard the mutated appellatives formed by combination with *gnathos* as of the masculine gender.

Thus the mammalian genus *Perognathus* of Wied was originally proposed as masculine and generally so accepted. *Erignathus* was proposed by Theo. N. Gill as masculine and has been universally so accepted. Among snakes we have *Leptognathus,* by Duméril and Bibron designated as masculine and so accepted by Günther, Jan and Cope; *Lycognathus, Ischnognathus* and *Petalognathus,* similarly proposed, and also accepted by Boulenger. Among the frogs we have *Cystignathus fuscus* Günther; *C. ocellatus* Tschudi, Peters; *C. labyrinthicus* Duméril and Bibron, Reinhardt

[1] The erroneous quotation *Leurognathus marmoratus* in the check list referred to by Professor Wilder was due to a lapsus and the use of the masculine gender in this case was quite unintentional. The incorrect citation of Dunn's *D. ochrophaea carolinensis* is also greatly regretted.

and Lütken, Steindachner; *C. pentadactylus* Peters; *C. mystacinus* Burmeister; *C. podicipinus* Cope, etc. Generic names ending in *gnathus* are as rare among birds as those ending in *ryhnchus* and *ramphus* are common (and needless to say no ornithologist, or other zoologist, has used the latter as neuters), but we have at least *Hemignathus* which they have accepted as masculine without exception, among them the purist of purists, Dr. J. Cabanis who is responsible for *Hemignathus procerus*. Finally, giving a few examples from the fishes, I quote *Hybognathus* accepted as masculine by Girard, Jordan and Gilbert, *Cochlognathus* by the same authorities, and last but not least *Syngnathus* proposed as a masculine by Linnæus himself and so accepted by all subsequent ichthyologists. In fact, it is probably not too risky to say that not until Cope discovered that the unmutated *gnathos* is feminine (reversing his own previous practise), were any of the mutated composites treated as feminine. It is also safe to say that most of the illustrious men who adhered to the masculine gender, when so indicated by the original proposer of the name, knew what they were about and showed proper "respect to the Greek language."

LEONHARD STEJNEGER

EVOLUTION OF BACTERIA

I WAS greatly interested in Professor Buchanan's article in SCIENCE[1] entitled "The Evolution of Bacteria." It is not my intention at the present time to take up at length those points raised by him which are admittedly matters of opinion. In matters of classification, there are many possible interpretations of available facts, which can not be easily proved or disproved. The conclusions reached were based on the facts at hand, though it was admitted at the outset that the facts were inadequate. The final answer to these questions can not be obtained at the desk, but in the laboratory. Most of the questions concerning bacterial relationship and descent can be tested experimentally by a study of their metabolic and antigenic characters, and it is such investigations that my article was intended to stimulate.

[1] SCIENCE, 1918, N. S., XLIII., 320.

Dr. Buchanan did, however, raise certain questions of fact which require some comment. In my argument in favor of the primitive character of bacteria the unique combination of the ability to subsist on simple inorganic compounds plus an extreme sensitiveness to sunlight, which excluded aid from that source, was advanced. This combination does not obtain in either plant or animal cells. Cells so constituted as to live on simple inorganic compounds without the aid of an external source of energy may, it seems to me, reasonably be considered as primitive. The sulphur bacteria, mentioned by Dr. Buchanan, contain a pigment which protects them from sunlight and which according to Englemann apparently functions somewhat like the chlorophyl in plants. Molisch dissents from Engelmann's view but claims that these bacteria must have organic food for their nutrition. Why they should be considered more primitive than the prototrophic bacteria is, therefore, not altogether clear.

In regard to the source of the volatile acids and alcohols for bacterial nutrition, I might refer to Kaserer's[2] report of nitrifying bacilli which convert $(NH_4)_2CO_3$ to formic acid and free N, or nitrates. These compounds are not, therefore, necessarily the product of carbohydrate fermentation.

The author draws the inference that by utilization of CO_2 I had in mind oxidation. It requires no profound knowledge of chemistry to realize that such a thing is not possible. What was implied throughout was an ability on the part of the cell to assimilate CO_2. Instances of such assimilation are numerous and this power is particularly evident among the nitrogen-fixing bacteria, the energy apparently being obtained from the oxidation of the N with a simultaneous reduction of the CO_2.

Reports of prototrophic denitrifying bacteria are admittedly not "common and well known." They have, however, been described by Hiltner and Strömer.[3] Somewhat more

[2] *Cent. f. Bakt.*, II. Abt., 1908, XX., 401.

[3] *Ref. Bot.*, 1904, XCV, 157.

advanced types flourishing in inorganic media containing nitrates and ethyl-alcohol have been described by Hohl[4] and by Burri and Stutzer.[5]

Because a group has not been extensively studied is no proof that it is not common. It is sufficient that representative types have been described. The group may well be common and yet not well known. The diphtheroids, the aciduric bacilli, the cellulose fermenters, are quite common, but were not well known five to ten years ago.

The resemblance between the red and yellow bacilli and the red and yellow cocci is only a superficial one. They produce pigments of the same chrome, but the pigments produced by the two classes of bacteria are *not* of the same type. The pigments produced by the cocci belong to the lipochrome group, give the typical lipocyanin test and their production is not affected by temperature. The pigments produced by the red bacilli do not give the lipocyanin test and their production is markedly affected by temperature. There are in addition marked metabolic differences between these two groups of organisms. The *B. prodigiosus* and related bacilli are more actively fermentative and many produce gas—largely CO_2. They as a rule liquefy gelatin actively while the red cocci as a rule do not. The bacilli are facultative anaerobes, the cocci are almost strict aerobes.

The ability on the part of *B. aerogenes* to fix nitrogen was reported by Lohnis[6] who studied the behavior of a considerable number of bacteria in this respect.

In conclusion I grant that my thesis has not been proved. Neither has it been disproved. If it stimulates investigation along these lines the paper will have been justified.

I. J. Kligler

ORGANIC CHEMICALS FOR RESEARCH, OR THE NEED OF A PHILANTHROPIST

Professor Roger Adams has recently published in these columns[1] an account of the admirable work which the laboratory of organic chemistry at the University of Illinois is doing to keep up the supply of certain organic chemicals for research and industrial needs. However, when one compares the limited list which that laboratory is manufacturing with the lists in the catalogues of German chemical firms, the realization comes home that the rarer organic preparations are no longer available and probably will not be available as long as the war lasts, and that, unless some measure is taken to prevent such an occurrence, Germany will again regain her trade in this line after the war.

It is well enough to *say* that we will not use German-made goods, but there would appear to be only one alternative, *i. e.,* the cessation, or at least the slowing up of research in organic chemistry if these essential starting materials are not available, or if they are available at relatively enormous prices.

The question therefore arises in my mind: "Why can not some man of wealth make his name blessed by endowing a laboratory which shall prepare these rarer organic chemicals against the needs of research work?" Undoubtedly the German supply houses sold many of these products at a loss before the war, counting the loss as a necessary part of their advertising propaganda, which was meant to build up the idea that Germany was the great chemical center of the world. Our commercial firms, unfortunately, do not see things in that light, and usually refuse to follow paths where a sure and handsome profit does not lead them.

If some man of wealth can not be found to whom this suggestion would appeal, what is there to prevent one of our research foundations from supplying the need? How could research and discovery be better furthered in this particular field of science than by furnishing the essential basic materials to a host of research workers in our colleges and universities? If such a plan as is herein proposed were adopted the United States would without doubt secure and retain first rank in the field of organic research. The initial cost would be comparatively small as measured by the scientific results, for the in-

4 *Land Jahr. der Schweitz*, 1906, 510.

5 *Cent. f. Bakt.*, II. Abt., 1895, I., 257.

6 *Cent. f. Bakt.*, II. Abt., 1907, XIX., 87.

1 Science, 47, pp. 225–228, March 8, 1918.

vestigators' salaries would be borne by the colleges and universities and where now a research foundation is giving to scientific investigation the services of one man, the same sum would assist a score or more of investigators.

In my own laboratories approximately half of the time of the investigators' laboratory work must of necessity be devoted to the preparation of essential starting-materials, pure amino acids, proteins, organic compounds, etc., in order to later use these for investigational purposes. These compounds are not available on the market except at exorbitant prices, tyrosine, for example, being quoted at $5.00 a gram (when obtainable), a price utterly out of proportion with the cost of preparation.

When one considers the limited funds available for research apparatus and chemicals in our colleges and the excessive cost of these materials, it is not surprising that no more research work is done; the surprising thing is that so much is done. The chemistry budget for our smaller colleges is usually $350–$600 per year and will probably not exceed $3,000 in many of our larger institutions. From this sum is first purchased the necessary equipment of apparatus and chemicals for the undergraduate laboratory courses and *if any funds remain* research chemicals or apparatus are secured. Unfortunately in many instances no funds remain for research work, the instructor can not prepare the compounds needed, for his time is too largely taken up by teaching, with the result that his research aspirations slowly die, for they have no soil upon which to grow. The question may arise: "Why does not such a man prepare his basic materials even if his time is limited?" In the first place there is no glamor in such work. In the second place, there are often eight or ten synthetic steps from raw products to finished material, and the necessary chemicals and apparatus for certain of these steps are not available. The rarer chemicals of which I am thinking represent in themselves and products of research (already published) and many of our college laboratories are not equipped for these steps, although they may be equipped to use the final product as the starting material for another investigation. It may be that the production of an intermediate product depends on a distillation in a vacuum of 0.01 mm. and no high-vacuum pump is available, etc.

Such an endowed laboratory as I have in mind would be in charge of an organic research chemist and would prepare and keep in stock all sorts of organic compounds for research workers. If an investigator desired a certain compound he could obtain this without cost or for a nominal cost providing that he first convinced the director of the laboratory that there was an actual need for the compound and that it would be used in bona fide research work, acknowledgment of such a grant to be appropriately made in the published results. If, on the other hand, an industrial demand for the chemical should arise (such as that which did arise due to the depleted supplies of dimethylglyoxime after the war began), the laboratory should charge a fee at least large enough to cover the cost of preparation. This would prevent the possibility of exploitation and in any event it should be definitely specified that there should be no resale of the article in question and any supply remaining after the completion of the approved research should revert to the endowed laboratory.

The above plan is probably not perfect, but I feel that there is in it at least a suggestion worthy of the serious thought of our scientific men or scientific societies, and I only hope that in some manner it may bear fruit. We must not again be dependent upon Germany for our research needs and unless some such endowed laboratory is brought into existence I can see no other alternative.

ROSS AIKEN GORTNER
DIVISION OF AGRICULTURAL BIOCHEMISTRY,
UNIVERSITY OF MINNESOTA

SCIENTIFIC BOOKS

Electrical Measurements. By FRANK A. LAWS. New York, McGraw-Hill Book Company, Inc., 1917. xiii + 719 pp. Price $5.00.

During recent years, writers of laboratory manuals have exhibited a constantly increas-

ing tendency to confine themselves to detailed directions for the performance of a number of more or less well selected but highly specialized electrical measurements. Such methods provide an easy introduction to the technique of the electrical laboratory and they are frequently useful in dealing with elementary students provided the underlying principles and their interrelations are clearly emphasized. But, when they become crystallized in book form, the several experiments are apt to occupy watertight compartments, between which the student sees very little relation. He performs the specified manipulations and draws the specified conclusions without obtaining the slightest inkling of their significance in electrical science, because he has been relieved of the study necessary for understanding. Moreover, owing to variations in equipment, even the best of such books are of little use except in the laboratories for which they were written.

Professor Laws's book is a welcome departure from these methods and can not fail to be greatly appreciated by serious students of electrical science. It is a clear and comprehensive treatise on modern methods of electrical measurement and includes sufficient discussion of typical instruments to guide the student in their practical application whatever may be the type of the instruments with which he has to deal. A few methods of purely historical interest are described, but for the most part the methods and instruments discussed are so thoroughly up to date that many of the more recent developments can be found elsewhere only in the original publications of their authors. Numerous references to original sources direct the student to first-hand discussions of the topics treated and to special methods and details beyond the scope of the present work.

The following list of chapter headings gives an idea of the field covered by the book: Measurement of Current; The Ballistic Galvanometer; Resistance Devices; Measurement of Resistance; Measurement of Potential Difference and Electromotive Force; Power Measurement; Measurement of Inductance and Capacity; Induction Instruments; Electricity Meters; Phase Meters; Power-factor Indicators; Synchroscopes and Frequency Meters; Graphic Recording and Curve Drawing Instruments; Instrument Transformers; Calibration of Instruments; Determination of Wave Form; Cable Testing.

The theory of methods and instruments is logically developed from fundamental principles and the conditions necessary for accuracy are discussed at some length in connection with practical applications. Galvanometers of various types are treated with the fulness merited by their general use as indicating and measuring instruments. The equation of motion of the suspended system is developed and integrated in its general form. Special cases are then derived by suitable choice of initial conditions and dynamical constants. The results thus obtained are utilized throughout the book in discussing the proper adjustment of resistance, control torque, period, damping factors, deflecting couple and sensitiveness to meet the requirements of the various uses of the galvanometer.

The typography of the book is clear and well arranged. The few misprints, inevitable in a first edition, are apparent and easily corrected. Most of the diagrams and illustrations are clear and well executed but a few of the halftones do not give a very clear idea of the instruments represented. The reader is assumed to be familiar with the fundamental principles of direct and alternating current systems of distribution and with the methods of differential and integral calculus. With this equipment he should find no difficulty in following the author's clear and concise discussions. The book is well adapted for use in senior college laboratories and it should also find a place in the working library of every electrical engineer.

A. deForest Palmer

SPECIAL ARTICLES

A NEW AND IMPROVED METHOD FOR OBTAINING PECTIN FROM FRUITS AND VEGETABLES

For more than two years past the writers have been engaged in the study of methods for

the isolation and purification of pectin. The studies, which were for the most part carried on at the Washington Agricultural Experiment Station, were at first concerned with the preparation and concentration of pectin for household use.[1] This work led to attempts to develop practical and inexpensive methods for the isolation of pectin in a pure state which should be equally available for the household or for commercial use. Such a method was developed and perfected in the autumn of 1917, but the transfer of the authors from the Washington Station to this office has delayed the preparation of a detailed report of the results for publication. The purpose of this preliminary note is to make the method immediately available pending the publication of a detailed paper now in the hands of the editor of the *Journal of Agricultural Research*.

The method is available for use with any pectin-containing material, since the objectionable flavoring substances of such materials as carrots are entirely removed.

The pectin is extracted from the material by the usual method of pulping, boiling with water and draining, this process being repeated until the pulp is exhausted. The watery extracts are combined, cooled, and a small quantity of a saturated solution of commercial alum, the exact amount being determined by the viscosity of the liquid, is slowly added and thoroughly mixed with the solution. Ammonia is now added in an amount slightly greater than that necessary to neutralize the acidity of the solution or until no further precipitate is formed. Precipitation will not occur if the solution is a concentrated, viscous one, and in all cases warming, or preferably diluting with hot water, hastens the coagulation of the precipitate and the clarification of the liquid. The voluminous insoluble precipitate of aluminum hydrate holds and carries out with it suspended solids and a considerable portion of the coloring matter.

As soon as the clarification is completed the solution is filtered and the residue upon the filter paper is preserved and dried for subsequent recovery of the aluminum. An ordinary laboratory grade of filter paper permits rapid filtration and retains the precipitate perfectly.

The water-clear filtrate, which contains only pectin, sugars, and traces of coloring matter, is heated to boiling, and magnesium-sulphate crystals are added, with constant stirring, until the formation of the flaky, grayish precipitate of pectin has ceased. The solution is then passed through filter-paper, preserving the filtrate, and the precipitate is freed from magnesium sulphate by washing with cold water and dried. The dry preparation may be readily reduced to a grayish powder, insoluble in cold water but readily soluble in warm acid solutions. It is entirely free from the coloring and flavoring matters of the material from which prepared. It may consequently be employed in making jellies from even the most delicately flavored fruit juices without danger of introducing foreign flavors. This makes possible the use not only of fruits but also of such pectin-rich but hitherto unavailable materials as the carrot as sources of pectin for jelly-making purposes. By reason of the purity of the product made by this method, it may be kept for prolonged periods in the dry condition without deterioration. In comparison with the ordinary commercial concentrated pectin there is an enormous reduction in volume and in cost of storage and transportation, a considerably decreased cost of production with a wider variety of raw materials available as sources, and a greatly increased range of usefulness.

An especially valuable feature of the process is that the chemicals employed may be almost completely recovered, thus reducing the cost of the process to a minimum. The aluminum salt is recovered as aluminum oxide by incinerating the residue from the first filtration. The magnesium sulphate is recovered as such from the final filtrate by concentration and the addition of a small quantity of alcohol, which causes the prompt crystallization of the salt, leaving coloring matters and sugars in solution in the dilute alcoholic liquid. Purifica-

[1] Caldwell, J. S., "A New Method for the Preparation of Pectin," *Wash. Agric. Expt. Sta. Bull.*, 147: 1–14, April, 1917.

tion of the magnesium sulphate is completed by washing the crystals with very dilute alcohol, after which they may be immediately used for further precipitation.

In the complete paper the authors will discuss in some detail the application of this method to the quantitative determination of pectin in the laboratory or in commercial jelly-making establishments. It is considered especially desirable at this time to point out that precipitation by magnesium sulphate may advantageously supplant the use of alcohol in the household test for pectin. While alcohol is not ordinarily available to the housewife, Epsom salts are to be found in every home and in almost every grocery store. By heating a small quantity of the aqueous extract of fruit, dissolving Epsom salts therein, and observing the amount of pectin thrown out of solution, one obtains an accurate measure of the pectin content of the fruit and is thereby enabled to form a judgment as to the amount of sugar necessary to form a jelly.

Discussion of many details of technique and of certain applications of the method here presented in outline are necessarily reserved for presentation in the full paper immediately forthcoming in the journal already named.

C. A. Magoon,
Joseph S. Caldwell
Office Horticultural and
Pomological Investigation,
Bureau of Plant Industry,
Washington, D. C.

THE CARE AND BREEDING OF ALBINO RATS

At this time when the government is using great numbers of albino rats and mice for inoculation purposes, numerous letters have been received from various sources asking for information regarding a source of supply and the care and breeding of these animals. This demand is so widespread that it is deemed most expedient to give this information in a simple form and to disseminate it to the greatest number of people by publishing it in this journal. In so doing those persons who are anxious to do their bit in this present crisis and who reside sufficiently near base hospitals and cantonments may be able to rear and supply these animals.

Albino rats and mice are exceedingly easy to raise. Their care and feed are practically the same and the cages in which they are kept can be identical. The cages for mice can, however, be much smaller. Our colony at the present time consists wholly of rats and the following applies strictly to them. It in general applies to mice also. These animals can ordinarily be handled by the bare hands without any danger of being bitten. Occasionally, however, a mother with young may be less docile if her young are disturbed. In such cases the use of a pair of heavy gloves is advisable. The oftener the rats are handled and petted the less likely they are to bite.

The cages in which our rats are kept and which we have found most satisfactory are made of one-fourth-inch galvanized wire netting with all the corners, edges and doors bound, or reënforced by galvanized iron (Fig. 1). They are made 12 inches high, 18 inches wide and 24 inches long. A partition of woven galvanized wire, provided with a sliding door (*D* 4 in. × 4 in.), divides this into two compartments 12 in. × 12 in. × 18 in. Each of these compartments is provided with a woven wire door (*D*, 6 in. × 6 in.) which slides up in runners made of galvanized iron (*Rn*). These doors are of ample dimensions to enable one to easily reach into all parts of the cage.

The bottom is separate and composed of galvanized iron 20 in. × 25 in. with three of the sides turned up 1 in. The front side is left flat to facilitate cleaning. The cage thus sits in this bottom and can be readily lifted off when cleaned. This process, which should be attended to at least once in two weeks, can be accomplished without handling the rats or without danger of their leaving the compartments to which they belong. This is done by placing the whole cage on a broad table, lifting the top about one half an inch and carrying it along to the bare table. The rats are thus forced along with the cage and the bottom left free. The old sawdust and excelsior used for bedding are now scraped out and a fresh supply added. The cage containing the rats in

their proper compartments is now replaced in the same manner that it was removed.

Clean fresh water is constantly supplied by means of an inverted bottle (B) provided with an air-tight rubber stopper (R) and glass tube 5 mm. in diameter (G). The spring clips (C) permit ready removal of the bottles for filling. The bottles are supported at the lower end on two bent wire nails (S) between which the glass tube passes (Figs. 1 and 3). We have found bottles containing eight ounces the most serviceable, as they are not too large and do not need refilling very often.

The albino rat is omnivorous in its diet and will devour almost anything a man will eat. They should be fed once each day. The food consists of cracked corn daily, such table scraps as are available, green stuff, such as lettuce, cabbage, etc. Where a large number of rats are being reared it is advisable to procure the refuse from a restaurant or hotel. Table scraps give a fairly balanced diet and

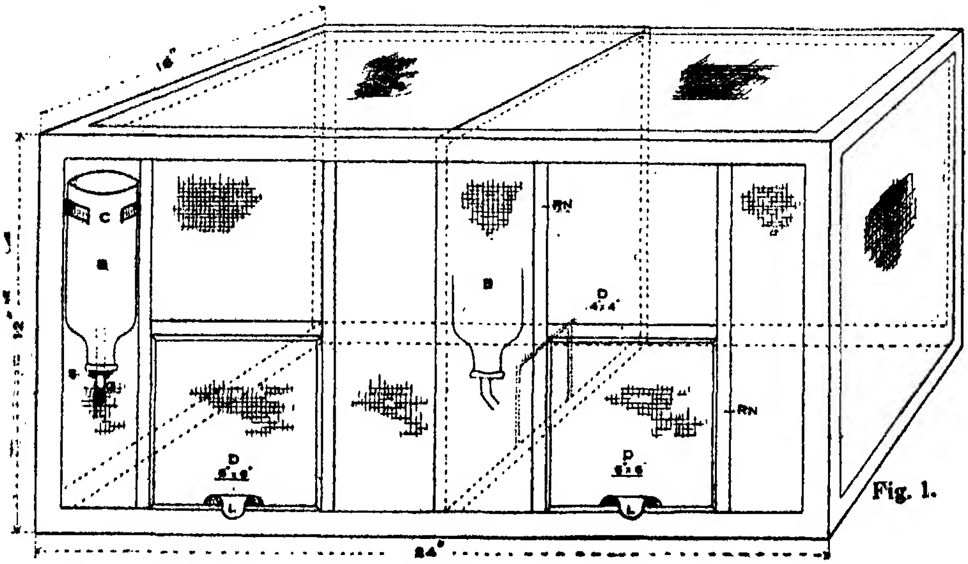


Fig. 1.

FIG. 1. Perspective drawing of the woven-wire portion of the cage showing the dimensions and plan of construction.

B, drinking bottle; *C*, spring clips for holding bottle; *Cg*, cage; *D* 4 in. × 4 in., sliding door in partition dividing the two compartments; *D* 6 in. × 6 in., sliding doors into cages; *G*, glass drinking tube from water bottle; *L*, lifts for sliding doors; *R*, rubber stopper; *Rn*, galvanized-iron runs for sliding doors; *S*, supports for bottle.

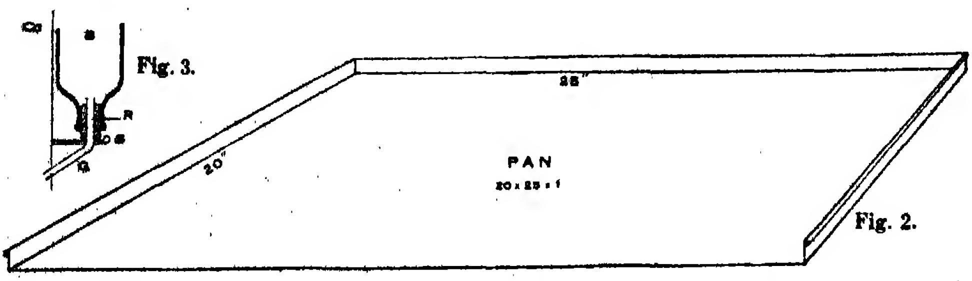


Fig. 3.

Fig. 2.

FIG. 2. Galvanized iron bottom, giving dimensions and plan of construction.

FIG. 3. Sectional view of drinking fountain showing the support of the bottle, *S*, and the manner in which the tube leads into the cage.

we have had excellent success with this food. If table scraps are not available, cooked beans, nuts and meat two or three times per week should be provided. The amount of food given should always be greater than will be consumed if one is desirous of quick returns. When rats are fed on a sufficient quantity of a well-balanced ration they are very prolific and grow rapidly.

A pair should be placed in each compartment. The female comes in heat about every five days and the period of gestation is approximately 21 days. The period of gestation is prolonged a few days if the female is nursing a litter of young during this time. Numerous instances are on record where mating has occurred the same day that young were born.

The number of young in a litter varies from one to fifteen, the average number being about six or eight. They grow rapidly and can be weaned at 30 or 35 days of age. If one desires to maintain a pure breed the young should never be allowed to remain with the parents after they have reached the age of fifty days, as breeding is likely to occur. A litter should always be weaned regardless of age as soon as (preferably just before) a new litter is born to prevent starvation of the newborn. In case the weaned litter is very young (25 to 35 days) milk should be added to their diet. To prevent inbreeding the sexes should be separated at weaning and confined in separate cages. With proper food, however, inbreeding can go on without apparent detriment for a number of generations.

The sexes in the young may be distinguished by the following characteristics:

The males may be recognized by a greater distance between the anus and the genital papilla.

In the male the genital papilla is larger than in the female.

At about 15 days of age the nipples are visible in the female.

After the hair covers the body a strip extending from the anus to the genital papilla remains almost bare in the female, while in the male this region is covered with hair except a small area immediately below the anus which later becomes the scrotum.

After the descent of the testes into the scrotum the males can readily be distinguished.

The age at which the young females become sexually mature varies between rather wide limits, but usually between 70 and 90 days. The earliest age at which we have found them sexually mature is 69 days. Lantz[1] records a case of sexual maturity at the early age of 35 days and Jackson[2] one at 49 days. Sexual activity in the females may continue until they have reached the age of 600 days. We have not determined the ages at which sexual activity begins and ceases in the male.

A great difference is noticed in the ability of females to produce young. Some appear to be sterile, while others have given birth to as many as nine litters. If one is desirous of securing numbers, the offspring from prolific breeders should be selected for breeding.

The rats do best in a well-ventilated room of fairly uniform temperature. Extreme temperature should be avoided.

Since these animals need daily attention they can not be shipped long distances unless provision is made for watering and feeding them en route. Our available supply is quite limited but we can generally furnish a few pairs to any one within shipping distance who is willing and able to breed rats for purposes of supplying the government, or for general scientific research.

The three main items for success are cleanliness, a sufficient quantity of a balanced ration, and avoidance of great changes in temperature. With these carefully looked after success is assured.

J. R. Slonaker

Physiological Laboratories of Stanford University

[1] David E. Lantz, "Natural History of the Rat," In "The Rat and its Relation to the Public Health," by various authors. P. H. and M. H. Service, Washington, 1910.

[2] C. M. Jackson, "On the Recognition of Sex through External Characters in the Young Rat," *Biological Bulletin*, Vol. XXIII., No. 3, August, 1912.

SCIENCE

FRIDAY, JUNE 21, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE ORGANIZATION OF THE MEDICAL PROFESSION FOR WAR[1]

I FEEL greatly honored by the election to the position of president of the American Medical Association. I recognize not only the honor but also the responsibility of assuming the leadership of the organized medical profession of the country at this time. The war has made unusual and exacting demands on us. The government and the people are looking to us to furnish in this great emergency not only the necessary number of medical men for the Army and Navy, but also the highest degree of medical service and efficiency. This is proving to be a war not simply between well-organized armies but between efficiently organized nations. It is now clear that in order to win the war we must organize the entire nation in such a way that every man and woman must become a useful part of a great and powerful national military machine. No part of such a great national organization is more important than the medical profession, and on this, the opening evening of this great war meeting of American physicians, it is my purpose to address you on the organization of the medical profession for war.

ORGANIZATION OF THE ASSOCIATION

There are in the United States more than 145,000 men and women licensed in the various states to practise medicine. Of these more than 81,000 are members of the

[1] Part of the president's address by Arthur Dean Bevan, M.D., Chicago, before the American Medical Association at the Sixty-ninth Annual Session, Chicago, June, 1918. The address is printed in the *Journal* of the American Medical Association.

American Medical Association, and more than 45,000 are Fellows. The American Medical Association is organized along the most democratic and representative lines. No profession in this or in any other country is more thoroughly and efficiently organized than the American Medical Association. The unit of the organization is the county medical society. It is the avowed purpose of the county society to receive into its membership all reputable practitioners who are legally qualified to practise medicine. The county medical society is a democratic organization. It is not, nor is it intended to be, a select and exclusive medical society. Its functions are educational and social. It exists for the purpose of using the united efforts of the physicians of that county for the benefit of the people and for the education of its members. Any county society that is not democratic and representative is not fulfilling its proper function. By virtue of membership in the county society the physician becomes a member of his state medical society and of the national society—the American Medical Association.

During the first half century of its existence, the American Medical Association was a rather loosely organized body. It was founded for the special purpose of elevating the standards of medical education and practise. Its ideals were high, and it accomplished a great deal of good. Not, however, until its reorganization in 1901 on broad democratic and representative lines, did it become in fact the organized medical profession of the country. The American Medical Association is not sectarian, but is broad enough to include in its membership all licensed physicians who honorably practise scientific medicine.

ACTIVITIES OF THE ASSOCIATION

Since its reorganization, the American Medical Association has had a record of splendid achievement. It has succeeded in elevating the standards of medical education in this country, which has been uneven and unsatisfactory, to a position where they are as high as those in any other country. It has improved the character of medical instruction until we can now state without fear of contradiction that the medical student can obtain as thorough and complete an education here in America as anywhere in the world.

Moreover, the American Medical Association has accomplished much through its council on medical education in cooperation with *The Journal*. Through these departments it has been of great service in creating a register of licensed practitioners. A register of medical students is now kept so that the association possesses a full record of the medical career of each licensed practitioner and medical student.

The American Medical Association and its constituent state medical associations have succeeded in securing improvements in the medical practise arts of most of our states protecting the people against ignorant and inefficient practitioners and securing better public health service.

The American Medical Association has through its Council on Pharmacy and Chemistry done outstanding, pioneer work against the unscientific and unnecessary use of drugs and against the prescribing of secret formulas and "quack" medicines. It has done more than any other medical organization to place drug therapy on a sound and scientific basis.

The Journal of the American Medical Association has become the largest and most influential medical periodical in the world. It has a circulation of more than 65,000 copies, and in the best sense it is the instrument that keeps the profession in touch with the affairs of the association, with sci-

entific medicine, and through well-prepared abstracts with the current medical literature of the world.

It is now more important than ever that these admirable activities of the association should be continued and amplified, and that steps should be taken to meet the new problems that will confront the association after the war. These will undoubtedly include the stimulation of medical research, the development of an adequate American medical literature, the creation of post-graduate medical facilities not only for our own medical men, but also for the medical men from other countries, who will find here in our great democracy a welcome and opportunities in medical instruction and medical research second to none. But these things can and must wait on the one great problem that confronts us now, *the winning of the war.*

DEMANDS MADE BY THE WAR

The problem that confronts the country in this war, as far as the development of the medical departments of the United States Army, Navy and Public Health Service are concerned, can briefly be stated in this way: If we raise an army of 3,000,000 men, 10 per cent. of this number will be in the medical department, that is, 300,000 officers and men, and of these at least 25,000 must be qualified physicians and surgeons. If we raise an army of 5,000,000 men, the medical department will contain 500,000 officers and men, and it will be necessary to have between 35,000 and 40,000 qualified medical men. At present there are more than 200,000 men authorized in the Medical Department of the Army. Of these, somewhere from 20,000 to 25,000 will be medical officers, and the balance enlisted men and nurses. If we create a navy of 500,000 we shall need 3,500 medical men. If we create a navy of a million, which is probable, we shall need 7,000 medical men. The need of the Public Health Service, although more modest, will be considerable, and must be met. No one can prophesy the extent or duration of the war, but we can say with certainty that it is the purpose of the American people to create and maintain the largest and most efficient navy in the world and to organize and train and equip an army large enough to win the war.

WHO REPRESENTS THE MEDICAL PROFESSION?

The efficient organization of the medical profession of this country for war is being splendidly accomplished by the cooperation between the Medical Departments of the Army and Navy and the organized profession, the American Medical Association. It has been unfortunate that a medical advisory committee which is not in any way representative or democratic, and which has no proper function in the efficient organization of the medical profession for war, should have been called into existence. A small coterie of specialists, of gynecologists and surgeons, no matter how eminent or how successful they may have been as promoters and exploiters of special medical societies, can in no way in this great emergency and in this great democracy represent the medical profession.

RESPONSE OF THE PROFESSION

At the outbreak of the war, the American Medical Association offered to the United States government its entire organization and machinery to assist in the enormous expansion that became necessary. Through the officers of the county societies, the state societies, and particularly through the columns of *The Journal,* the needs of the government were placed before the organized profession of the country, and they responded splendidly to the call. So far

25,000 have gone into the Medical Departments of the Army and Navy. No other profession or calling has responded more promptly to the needs of the country than the medical profession. The great bulk of the medical men who have gone into the government services were members of the American Medical Association.

The demands made on the medical profession by the war are so great that it is evident that in order to secure the necessary number of medical men for the government, and at the same time prevent hardships in some communities and institutions, it is necessary to organize the entire profession of the country in a systematic way. It therefore became necessary for the American Medical Association, acting with the Surgeon-General's Office, to take a census of the available medical men in the United States in each state, in each county, in each medical school and in each hospital, and to attempt to secure from each one of these different units at least 20 per cent. of the medical men. This plan will enable the government to secure the necessary number of medical officers for an army of 5,000,000 men or more, and a navy of 1,000,000 without any great hardship to any community or to any institution. It is evident that a plan of this kind is absolutely essential, and it is the purpose of the American Medical Association through its county and state societies and its national organization to create such a systematic classification and secure the adoption of this plan. Such a plan means a voluntary draft of the medical profession by the profession itself. The medical profession will supply the men needed by the government. No conscription, no compulsion will be required.

THE HONOR ROLL

The survey has been completed, and was published in *The Journal*, June 1. It gives the honor roll of the men who have already gone into the service from each county and state society. It gives the number of men under 45 and under 55 years of age in each county and the percentage of men who have volunteered. Up to this date about 15 per cent. of the total number of men have volunteered. The Surgeon-General of the Army has called for 5,000 more medical officers, and the Surgeon-General of the Navy needs about 2,000. It becomes necessary for us to raise the total number of medical officers this year to about 30,000, which means nearly 22 per cent. of the medical men of the country.

As president of the association, I desire to call the serious consideration of each county medical society to the fact that in order to do its duty it should furnish at least 20 per cent. of its members for military service. This situation should be met fully and promptly by each county medical society. In order to prevent hardships to communities due to lack of medical service, and in order to prevent the crippling of medical schools and hospitals, no community and no institution, unless it is clearly oversupplied, should be allowed to furnish more than 50 per cent. of its medical men. As far as possible the quota from each county should be filled by men under 45 years of age. If this is not possible men up to 55 will be taken. As fast as each county fills its quota of 20 per cent.—and this should be done by each county within the next few months—the secretary of the county medical society should notify the secretary of the state medical association and the secretary of the American Medical Association of that fact.

THE SUPPLY OF MEDICAL MEN

Profiting by the experience of the great nations that entered the war in 1914, the medical profession of the country, and the

government, have very wisely taken steps to prevent the disruption of our medical schools, and I am glad to say that our national government adopted the suggestion made by the Surgeon-General to allow medical students to be commissioned in the enlisted Medical Reserve Corps and have them detailed to complete their medical education and to serve a year in a hospital as interns before they are called into active service. This was to apply to the men who have already studied medicine in the medical school proper for one year. In order to insure the further supply of medical students to meet the demands of a great and prolonged war, the effort is being made to have this apply also to the men who are taking their premedical work in universities. It is necessary to have these men continue their medical studies in order to insure the continued supply and the necessary number of medical men.

The United States is the only great reservoir of medical men in the world. The medical professions of Great Britain and France, of Italy and Belgium, and this is probably more true of enemy countries, have been well nigh exhausted by this war. They delayed making plans for a continued supply, their medical schools became disrupted, and they are already suffering for medical men in their armies and in their civil life. Major Horace B. Arnold, chairman of the council on medical education, who is on active duty in the Surgeon-General's Office looking after the problem on medical education for General Gorgas, has this matter now under consideration, and it is to be hoped that he will succeed in securing rulings that will enable our premedical students to continue their medical courses. If the need for medical men becomes very great we can adopt a continuous session and graduate men in three years. The senior students in the medical schools should have special courses in military surgery. I would recommend that if possible one or two competent medical officers be assigned to each medical school for this purpose.

EXPANSION OF THE MEDICAL DEPARTMENT

The enormous problem that was presented to the Surgeon-General's Office by the war may be realized in a striking way by the statement that the development of an adequate medical department of 3,000,000, men means that less than 2 per cent. of such a department is represented by the men in the service at the time of the outbreak of the war—that more than 98 per cent. of the men must be taken from civil life, and must be given the necessary military training to fit them for active duty in the field. This enormous problem is being adequately and splendidly met. A small medical department which existed before the war has formed the leaven necessary to change a great body of physicians coming from civil life into efficient military surgeons and efficient hospital and ambulance units. Special training camps for medical men were formed at Fort Riley, Fort Benjamin Harrison and Fort Oglethorpe. Gradually the work done by these different camps is being concentrated at Fort Oglethorpe, where an enormous military medical university of 40,000 officers and men is being created. Here the enlisted men will receive their necessary training in small and large units, and the medical officers will receive their necessary military instruction and instruction in such medical work as will peculiarly fit them for their military duties.

GENERAL GORGAS

Standing out prominently in the development of the great Medical Department of the Army is a great figure, the figure of Surgeon-General Gorgas, who in a very quiet way has demonstrated again the fact

that he is one of the greatest organizers in sanitation and in military medicine and surgery. It is most fortunate that in this emergency work of the medical department it was found in such strong and capable hands. General Gorgas is one of the great assets of this country to-day. The splendid work that he is doing he should continue to do throughout the war, and the organized profession of this country could do no greater service to the government than to make clear to the Washington authorities that they are unanimous in their support of Surgeon-General Gorgas, and regard him as the best man in the country for the head of the Medical Department of the Army.

General Gorgas has succeeded in surrounding himself with the strongest, most efficient men, and has shown great wisdom and judgment in placing specially qualified men at the heads of the many departments under his control. The men he has chosen from the regular corps as the heads of divisions are strong and efficient: it is only necessary to mention such men as Welch, Vaughan, Billings, Mayo, de Schweinitz and scores of others, who in civil life are the recognized leaders in their special field of work, recognized not only in this country, but throughout the world.

We are equally fortunate in finding the Medical Department of the Navy in the efficient hands of Admiral Braisted, who has succeeded in meeting the great expansion made necessary by the war in the most satisfactory way.

The medical profession is also proud of the splendid service that has been rendered by the Public Health Service under the able leadership of Surgeon-General Blue.

HEALTH DURING MOBILIZATION

The mobilization of this country for war is an enormous task. To create an army of from three to five million men or more, where before we had less than 100,000, and create a navy of from 500,000 to 1,000,000 is an undertaking that had never before been worked out by any country. It was necessary that this enormous mobilization should be done as rapidly as possible, and from the rapidity and the enormous size of the mobilization it was inevitable that the medical organization could not accomplish the impossible and secure at once ideal results. Yet when we compare the mobilization of the United States for war with other countries we find cause for congratulation. Up to the time of our mobilization the army of Japan had held the record for the lowest mortality of any country during mobilization, and the best care of its soldiers from a medical standpoint. In the Japanese mobilization there was a mortality of 20 per thousand. In our mobilization there has been a little less than 10 per thousand. In other words, the showing of our mobilization from the standpoint of mortality was twice as good as the record held by any country up to that time. There have been epidemics of contagious diseases, such as measles, mumps and meningitis, and the total number of cases occurring among 2,000,000 men has been somewhat startling; but when these facts are analyzed and it is found that the mortality in our army is less than the mortality in civil life of the same number of men of the same age, picked by insurance companies, we can realize what splendid results have been accomplished.

The people of this country, the mothers and fathers and wives, whose sons and husbands are in the Army and Navy, are entitled to know, and it will be a great comfort to them to know, that the health of these men is better looked out for than when they were in civil life, that the dangers that they run from disease are less than when they were in civil life, and that when

they are sick or wounded they will receive as good care, as high a class of medical and surgical service, as could possibly be obtained in civil life. This is true because our best men have gone into the medical service, and the government is providing the medical departments with every facility necessary to give our soldiers the best medical care.

THE LABELLING OF FAIR EXHIBITS AS AN AID TO AGRICULTURAL PRODUCTION

IN past years and even at this time, when increased conservation and production of food is so desirable, the people of North America invest a tremendous sum in over 2,000 county fairs and similar agricultural exhibitions. This investment loses much of its effectiveness—perhaps more than half—because of lack of labels, scarcity of labels or imperfect labels.

By labels is not meant such labels as are used in the great museums where too much attention is given to the specimen and too little to the desirable effect of the exhibit or the effect of the label, if it be present at all. Over sixteen years' experience in the American Museum of Natural History, perhaps the largest museum on the continent, convinced me that useful labels are more rare and more valuable than the exhibits.

At the Central Canada Exhibition in Ottawa was once exhibited a very interesting hand-woven fabric apparently of farmer handiwork, but close examination of the exhibit failed to reveal where it was made, by what class of people, its value, or where such fabrics could be obtained. Otherwise intelligent people have been known to lay in a stock of fall fruit, part of which spoiled before the winter was over. A label at the fair on fruit preservation would have saved this loss. When one views the machinery at a fair he is often at a loss to know for what it may be used. Many similar examples could be given. Probably more than half the people who visit a fair grope their way through without understanding many of the exhibits. They go as a lark, but could learn at the same time things that would make them more useful to the whole country. An additional investment, small in proportion to the present whole cost of fairs, would change them from amusements or casual advertisements to educational institutions resulting in diffusing the best agricultural knowledge discovered by the government experts.

An additional investment of less than one cent per exhibit would provide suitable educational labels and probably double, if not multiply the productive national value of the fairs many fold. It is not proposed that each fair should write and print its own labels. This would mean that the ignorant or least skilled would write the labels, whereas we have intelligent and skilled specialists in provincial or national agricultural departments, as well as in agricultural colleges and experiment stations. It would also mean that there would be as many labels written as there are fairs, a tremendous overlapping of effort and expense, while one writing would do for all.

It is not advocated to label each exhibit, for instance each cow, but to label each breed. In the case of large exhibits with many individuals, as of Clydesdale horses, one label would be put at each end of each row of stalls and perhaps in one or more places between.

Perhaps labels should not be made in this particular way for everything in every fair, but for those things that are common to most of the fairs. One could take the list of exhibits at a typical fair and make a label for each class of exhibits, such as Holstein cows, Plymouth Rock chickens, northern spy apples, Hubbard squash and windmills. They would not be advertisements for any firm.

Each label should be written by the leading expert in that particular sort of exhibit—breed of cattle, swine, bee, wheat, potato, apple, gang plow, threshing machine, windmill, motor, or what not. This label should be criticised by many other experts and then rewritten by a man who is an expert in interpreting facts to the people—to farmers and

others who are not scientists. Many an agricultural bulletin is not read or is thrown away by farmers because it is too technical or because what they wish to know is buried in hundreds of pages of detail too technical for their understanding. Possibly an expert advertising writer could condense the labels written by experts down to essentials and rewrite them in language understood by the average farmer. Such labels consequently could not give the name and address of the owner, price, or other local details, but each label should be an adequate article on the subject, including references to both the best literature and to that which is most available, such as experiment station reports. It should contain nothing that could be replaced by a more important statement. Possibly the labels would cover an 8×12 inch card. They would tell, for instance, which breed of cow was good for milk, which for beef, what to feed, when to water, the general values and all such useful information. They would help the city dweller to cooperate with the farmer, and also in connection with buying, storing, drying, or otherwise preserving food. They might assist mechanics to know better how to invent and to make farm machinery.

These labels could be printed by national or provincial governments and distributed to each fair management so that each exhibit might teach to the farmers and other citizens who need the knowledge the essentials of increasing and improving the country's food supply.

The labels may be bound into a book, or rather the same type may be used to print off a guide-book or elementary agricultural encyclopedia, thus killing two birds with one stone, as has been done in the case of the imperfect and incomplete preliminary edition of the Handbook of the Rocky Mountains Park Museum, where one type setting supplied a handbook and labels for 18 museums, a zoó, a paddock and other uses. The same labels may also be illustrated with lantern slides or moving pictures and thus serve as lecture notes which may be arranged in any desired order. If a local fair wishes to add advertisements or labels of unusual local products not common to all fairs, such as peanuts or sweet potatoes, these labels may be prepared and printed locally for binding in at the back. In case the local authorities wish such advertisements or labels to local products added in the body of the book, then the originating or central office may supply electros or matrix of the standard label matter.

This plan would give far more accurate labels and handbooks than if each fair had its relatively unexpert men compose the matter. It would also save the useless expense of each fair composing its own labels and setting its own type.

Harlan I. Smith

Geological Survey,
Ottawa, Canada

SCIENTIFIC EVENTS

THE COORDINATION OF SCIENTIFIC PUBLICATION[1]

The coordination of scientific publication formed the subject of a recent conference arranged by the Faraday Society under the chairmanship of Sir Robert Hadfield, when a number of interesting problems bearing on the desirability of a fuller cooperation amongst our scientific and technical societies were discussed. Both in the reading and publication of papers there is, at present, a considerable amount of overlapping and lack of coordination, with the result that much valuable work is either lost or overlooked owing to communications being made to societies which are not especially associated with the subject-matter of the investigations concerned, and much benefit would undoubtedly result from a federation of interests in this respect. Whilst there is a general consensus of opinion that it is essential to maintain the individuality of each society in regard to the reading and publication of papers, and that any attempt to pool communications for later distribution by a central organization is undesirable, much effective cooperation could be secured between kindred societies by the arrangement of joint meetings and conferences with the object of

[1] From *Nature.*

promoting united work on problems of common interest. Borderland subjects merit special consideration from this point of view.

The publication of the proceedings of such meetings in the transactions of the several societies concerned would be much facilitated by the adoption of a uniform size and type for the publications of societies dealing with allied subjects, so that each could include such papers in its journal or distribute them as self-contained reprints of a standard size. Similar uniformity is perhaps not practicable for all scientific and technical publications, but in so far as it can be adopted it would add much to the accessibility and the utility of the recorded work.

Organized collaboration is also desirable by means of which the members of scientific and technical societies should have opportunity of knowing what papers are being contributed to societies other than their own, apart from their later publication either in the journal of the society concerned or in the form of abstracts. The proposal, which, it is understood, is being considered by the Board of Scientific Societies, to publish a weekly journal of announcements would meet this want, and it is to be hoped that the board will decide to issue such a publication as soon as possible. Meanwhile, individual societies could aid in this direction by publishing in their journals both the announcements of cognate societies and short summaries of papers read previous to publication, so that the subject-matter is brought to the notice of those interested at as early a date as possible. A method of mutual exchange to facilitate such cooperation could be easily arranged, and would in no way detract from, but rather add to, the interest in the later full publication of papers.

Apart from original contributions, the publications of most societies include abstracts of scientific and technical literature published both in our own and in foreign journals. In so far as such abstracts include subjects of common interest to members of kindred societies, there is at present a great deal of overlapping which could be advantageously eliminated by organized collaboration. We have, in the past, been far too reliant in many subjects on the foreign, and especially on the German, journals for our supply of the world's scientific and technical literature, and it is high time that we became independent and self-supporting in this respect. Effective cooperation should achieve this desirable end for each group of cognate subjects; and whilst the method of collaboration would depend to a considerable extent on the character of the subject, a common journal of abstracts for each group of societies would, in the majority of cases, prove the most advantageous plan. Although a scheme of this character would necessarily decrease the bulk of the publications of each society, the original contributions which mark their individuality would be given greater prominence, time wasted by the rereading of the same abstract in several journals would be saved, and considerable economies in publication would be effected.

Much attention is being directed at present towards the unification and coordination of scientific effort. The coordination of scientific publication, which has made some progress in the directions indicated during recent years, should certainly continue to occupy a prominent place amongst these problems of reconstruction.

VITAL STATISTICS OF ENGLAND AND WALES

THE Registrar-General has made public the following statement showing the birth-rates and death-rates and the rate of infantile mortality in England and Wales and in certain parts of the country during 1917.

ENGLAND AND WALES

Birth-rate, Death-rate and Infant Mortality during the Year 1917 (Provisional Figures)

	Birth-rate per 1,000 Population	Civilian Death-rate per 1,000 Civilian Population	Deaths Under One Year per 1,000 Births
England and Wales	17.7	14.4	97
96 great towns, including London (population exceeding 50,000 at the census of 1911)	18.0	14.6	104
148 smaller towns (populations from 20,000 to 50,000 at the census of 1911)	17.9	13.1	93
London	17.4	15.0	103

The following table, by the *British Medical Journal* compiled from the statements published for ten years, will be of interest. The figures (not standardized) of the death-rates do not disclose any very distinct movement; the deaths of infants appear to indicate a slight increase. The most disquieting set of figures are those showing a further marked decline in the birth-rate since 1914.

ENGLAND AND WALES

	Births per 1,000 Total Population	Deaths per 1,000	Deaths Under One Year per 1,000 Births
1908........	26.5	14.7	121
1909........	25.6	14.5	109
1910........	24.8	13.4	106
1911........	24.4	14.6	130
1912........	23.8	13.3	95
1913........	23.9	13.7	109
1914........	23.6	13.9	105
1915........	21.9	15.1	110
1916........	21.6	14.0	91
1917........	17.7	14.4	97

CIVIL ENGINEERS AND THE ARMY

The War Department states that two thousand engineers are needed immediately by the United States Army for commission as first lieutenants and captains. The chief of engineers has outlined a plan of campaign by which it is hoped to obtain the men needed without delay. A board of examiners will be sent out from Washington to visit about 33 principal cities.

Engineers, civil, mechanical, mining and electrical, will have an opportunity to go before the board and be examined. Those passing the examinations will be commissioned at once and sent to an engineer officers' training camp, either at Camp Lee, Petersburg, Va., or Camp Humphreys, Va., near Washington. They will be on officers' pay while training and at the completion of their courses will be assigned at once to duty with the engineer troops.

Engineering societies and institutes will be provided with application blanks to be distributed among their members and friends in the profession. Engineers who do not obtain blanks in this way should address the Chief of Engineers, United States Army, Washington. These forms, when properly filled out, should be returned to Washington. After they have been scrutinized with a view to ascertaining the fitness of the applicants, word will be sent out telling the men when and where to appear for mental and physical examinations.

Following are the requirements that must be met:

Age Limits.—First lieutenants, 32 to 36 years; captains, 36 to 42 years. These limits may be extended in special cases, but no man of draft age will be considered.

Citizenship.—All applicants must be citizens of the United States.

Qualifications.—Applicants must be actively engaged in the practise of the engineering profession, and be in good physical condition. No set rules have been adopted as to professional qualifications and experience. The examining board will determine each applicant's case. Applicants must possess the requisite qualities of leadership and temperament to fit them for the command of troops.

It is the hope of the chief of engineers to have all men who pass the examinations commissioned within ten days or two weeks. Traveling expenses of 7 cents a mile to the training camp will be allowed to those who receive commissions.

WAR WORK OF MINING ENGINEERS

Heads of practically every "war-work" division of the government will discuss vital war problems with 200 of the country's leading mining engineers, representing the American Institute of Mining Engineers, at a dinner in the Food Administration Cafeteria on the evening of June 21. To learn new ways in which the mining engineer can contribute his services, already great, toward the winning of the war is the aim of the gathering, which has been planned in honor of the board of directors of the institute. There are some 700 of the institute's membership of 6,700 devoting their entire time to war service.

Those who will discuss future work for the institute in the war are practically all members of the institute. They include Herbert

C. Hoover, food administrator; Charles M. Schwab, director-general of the Emergency Fleet Corporation; John D. Ryan, director-general of the Aircraft Production Board; Vance McCormick, chairman of the War Trade Board; W. L. Saunders, chairman of the Naval Consulting Board; Mark L. Requa, head of the Oil Division of the Fuel Administration; Sidney J. Jennings, president of the American Institute of Mining Engineers; Benedict Crowell, Assistant Secretary of War, and Pope Yeatman, of the War Industries Board. Francis Peabody, chief, explosives section, Bureau of Mines, will be the toastmaster.

Members of the American Institute of Mining Engineers are active in a wide field of war work including the Engineer Officers' Reserve Corps, Ordnance and Signal Corps Branches of the Army and Navy, Aircraft Production, Food and Fuel Administrations, War Industries Board, War Trade Board, and the Department of the Interior. Several members of the institute have also joined the Royal Engineers of the British Army. The arrangements for the conference are in charge of Van H. Manning, director of the Bureau of Mines. In the afternoon the board of directors of the institute will hold a meeting at the Bureau of Mines.

At a meeting on June 20 a Washington section of the American Institute of Mining Engineers was formed. Although remote from the country's mining centers, Washington now contains more mining engineers than any other city.

SCIENTIFIC NOTES AND NEWS

DR. ALEXANDER LAMBERT, of the College of Physicians and Surgeons, Columbia University, was elected president of the American Medical Association at the Chicago meeting on June 13. Admiral W. C. Braisted, Surgeon-General of the Navy had a nearly equal number of votes. Dr. Lambert is medical director of the American Red Cross work in France, and president of the New York State Medical Association.

AT the recent commencement of New York University, the degree of LL.D. was conferred on Surgeon-General William C. Gorgas, and the degree of doctor of public health on Dr. Charles Edward Amory Winslow, professor of public health at Yale University.

AT its commencement exercises held on June 12, St. Lawrence University conferred the degree of doctor of laws on Dr. Frederic S. Lee, professor of physiology in Columbia University.

SIR NAPIER SHAW, president of the International Meteorological Committee, has been appointed scientific adviser to the British government for the period of the war. Sir Napier has been director of the British meteorological office since 1905.

OLIVER HEAVISIDE, the distinguished English mathematical physicist, has been elected an honorary fellow of the American Institute of Electrical Engineers. The only other honorary fellows are: Marconi, Ferranti, Blondel and C. E. L. Brown.

PROFESSOR L. V. KING, of the Macdonald Physical Laboratories, McGill University, was elected president of Section III., Chemical and Physical Sciences, at the thirty-seventh meeting of the Royal Society of Canada, recently held in Ottawa, Canada. Professor King has been carrying on a series of practical researches for anti-submarine warfare and other work on behalf of the British Admiralty.

THE Franklin Institute has awarded the Howard N. Potts medal to Dr. Alexander Gray, of Ithaca, N. Y., for his paper, entitled "Modern dynamo electric machinery," which is "an exhaustive discussion of the design of dynamo electric machinery." The institute has awarded its Edward Longstreth medal of merit to Professor H. Jermain Creighton, of Swarthmore College, for his paper, entitled "The deteriorating action of salt and brine on reinforced concrete," which presents "the results of an original and scientific investigation in a matter of great practical importance. An Edward Longstreth medal of merit has also been awarded to Dr. J. B. Whitehead, of Baltimore, for his paper, entitled "The electric strength of air and methods of measuring high voltage," which gives "a clear exposition of

the underlying principles of the phenomenon of the electric corona at high potentials."

Lord Rothschild has been elected an honorary member of the recently founded Entomological Society of Spain.

Samuel R. William, professor of physics at Oberlin College, has been appointed Ernest Kempton Adams fellow by Columbia University.

Sir William Arbuthnot Lane, consulting surgeon to Guy's Hospital, Sir James Mackenzie, physician to the London Hospital, and Colonel Herbert A. Bruce, consulting surgeon of the British Armies in France, are now in this country to attend American medical conferences.

Major George W. Norris, of the University of Pennsylvania, who went to France nearly a year ago with Base Hospital No. 10, now No. 16, with the British Expeditionary forces, has been assigned, in addition to his other work, consultant in general medicine for Advance Section S. O. S., Zone of the Advance. He is attached to the American Expeditionary forces.

W. A. Cochel, for six years head of the department of animal husbandry, Kansas State Agricultural College, has resigned his position to become secretary of the American Shorthorn Breeders' Association. He will probably continue to make his home in Manhattan.

President W. A. Jessup, of the University of Iowa, has received a letter from Professor C. C. Nutting, head of the expedition to the British West Indies, stating that the party had reached the island of Barbados safely after a thirteen-day voyage from New York City. Each of the nineteen members in the company is in good health, and prospects are favorable for a successful outcome. The explorers are now in government quarters and have equipped excellent laboratories and aquariums for the study of sea life.

Professor Vaughan MacCaughey, professor of botany at the College of Hawaii, Honolulu, will have charge of the courses in biology and field natural history at the Chatauqua Institution Summer Schools, Chatauqua, New York. En route he will lecture at educational centers on "The Islands of the Pacific and the World War."

Sir Alexander Pedler, F.R.S., known for his research work in chemistry, for many years professor of that science in the Presidency College at Calcutta, later vice-chancellor of the Calcutta University and minister of public instruction in Bengal, died on May 13, aged sixty-eight years.

The death is announced in *Nature* of Dr. R. G. Hebb, consulting physician and physician pathologist to Westminster Hospital, lecturer on pathology at Westminster Hospital Medical School, reader in morbid anatomy at the University of London, and editor of the Journal of the Royal Microscopical Society.

The Civil Service Commission announces a registration examination for geodetic, hydrographic and magnetic computors in the United States Coast and Geodetic Survey. This is a continuing examination and the entrance salary is $1,200 per annum. Detailed information regarding the requirements and the work done by the computers will be furnished upon application to the U. S. Civil Service Commission or to the U. S. Coast and Geodetic Survey, Washington, D. C.

UNIVERSITY AND EDUCATIONAL NEWS

A $50,000 bequest to the University of Pennsylvania is included in the will of the late Dr. William C. Goodell, to be used to endow a chair of gynecology.

A letter from the department of registration and education of the state of Illinois, states that after October 15, 1918, no medical college will be recognized as in good standing in Illinois unless it requires for admission two years of work in an approved college of liberal arts or a fully equivalent education.

The University of Wisconsin reports the receipt of gifts amounting to $100,000 which, with an appropriation of $50,000 from the legislature of 1917, will be used in the construction of a new infirmary for the medical school.

Dr. H. L. Rietz, of the University of Illinois, has been made head of the mathematics at the State University of Iowa. He will suc-

ceed Professor A. G. Smith, whose death occurred in the fall of 1916.

Appointments at Cornell University have been made as follows: F. K. Richtmyer, professor of physics; John B. Bentley, jr., professor of forestry; Charles L. Gibson, professor of surgery, to succeed the late Professor Stimson; John A. Hartwell, associate professor of surgery and William C. Thro, professor of clinical pathology, Medical College, New York.

William S. Taylor, acting professor of rural education at Cornell University, has been appointed professor of agricultural education at Pennsylvania State College.

Dr. A. R. Cushny, F.R.S., professor of materia medica and pharmacology in the University of London (University College) since 1905 has been appointed to the chair of materia medica in the University of Edinburgh. Dr. Cushny was professor of pharmacology in the University of Michigan from 1893 to 1905.

DISCUSSION AND CORRESPONDENCE

PYRHELIOMETRY AND SOLAR RADIATION

To the Editor of Science: I hope it may interest your readers, and more fully explain the discrepancy between Professor Bigelow's work and mine, if you can find space for the accompanying letter.

May 14, 1918

My dear Professor Bigelow:

1. I received yesterday from your publishers a complimentary copy of your new book entitled "Treatise on the Sun's Radiation." You are kind to have it sent to me.

2. I received to-day your communication on a 26.68-day solar synodic period.

3. Some time ago I received some other data from you relating to observations and computations of radiation.

4. While I appreciate your kindness in remembering me personally, I am obliged to tell you that I can not at all accept your views and I do not think you either fully understand or fairly weigh our work. My reasons are partly given below.

5. Among the words you use most is "Pyrheliometer." We carefully made and standardized Silver Disk Pyrheliometer S. I. III., at your request, and sent with it an accurate description of the method by which it must be read and reduced in order to give results to correspond with its constant of calibration. In your book "Atmospheric Circulation and Radiation," pages 263 to 267, I am surprised to see that you describe and *prescribe* another method of using it whereby it *can not give results agreeing with its constant of calibration.*

6. You use this word "Pyrheliometer" and its modifications often very objectionably when you mention our work. You make it appear as if we attach weight to empirical processes of extrapolation of total radiation of all wave-lengths combined. If an observer could operate on the moon, a pyrheliometer would be a very much more valuable instrument than it is here, and I believe you and others could not then avoid the true conclusions as to the value of the solar constant. Unfortunately, owing to the unequal transparency of the earth's atmosphere for rays of different wave-lengths, it is absolutely necessary to use spectrum-energy analysis to measure the solar constant of radiation, as Langley showed. We use a linear bolometer to measure the intensity and changes of intensity of all parts of the spectrum. We have employed it at Washington, Bassour, Hump Mountain, Mount Wilson, and Mount Whitney. In our experiments the solar beam traversed paths of air ranging from that where the sun was nearly vertically overhead at Mount Whitney, to that with the sun on the horizon at Mount Wilson. Anybody interested can learn exactly how we worked by studying our published papers, particularly Volumes II. and III. of our *Annals* and our paper "New Evidences on the Intensity of Solar Radiation Outside the Atmosphere," Smithsonian Miscellaneous Collections, Vol. 65, No. 4.

In all this work we treat the pyrheliometer as a subsidiary instrument. Its sole use and purpose in our investigations is to enable us to express the readings of the bolometer in calories.

As a result of spectro-bolometric investigations over fifteen years of time, we have shown that the solar constant is 1.93 calories, and the sun an irregular variable star. Others, Clayton and Bauer particularly, have shown how the solar variations we have discovered affect terrestrial things. If our results were wrong these correlations would not be found.

7. Not everybody has a spectro-bolometer. You haven't any, for one. From a wealth of experience that nobody else in the world ever had in the measurement of solar radiation, we have put out some tabular data and empirical formulæ connecting pyrheliometry and psychrometry with the solar constant. We did this, not because we had any occasion for them ourselves, but so that observers

who had pyrheliometers, but couldn't afford the expense of money, time, and experience necessary to really observe solar radiation satisfactorily by spectrum-energy work, might get approximate results of at least moderate value. It is to be distinctly understood that these empirical methods of solar constant work by pyrheliometry, though based on our work, are likely to yield results several per cent. from the truth, owing to differences in the atmospheric transparency due to various causes, and especially to the variable influence of water vapor. Pyrheliometric methods are mere economical make-shifts when unaccompanied by spectrobolometry.

8. You are, I am certain, misled in your attack on our use of Bouguer's formula of extrapolation when applied as we applied it to homogeneous rays. See for instance our paper "New Evidences on the Intensity of Solar Radiation Outside the Atmosphere." Logically conceived the mathematical treatment consists in diminishing the path of the sunrays in every layer of the atmosphere proportionally until none remains. The fact that this can not *conveniently* be carried through *experimentally* beyond the point corresponding to the atmospheric thickness found in a vertical solar beam does not prove that a continuation such as can be logically conceived up to the point where each thickness becomes zero is mathematically unsound. Imagine, for instance, a tube to be erected from the observer to the outside of the atmosphere, and by side tubes appropriately dimensioned let the atmosphere within the tube be exhausted until none remains. This fits the logical process applied with Bouguer's formula. No mathematician but you can see in it anything objectionable, so far as I know.

9. In order to verify, as far as could be done, the sound theoretical and experimental conclusion that if the standard pyrheliometer could be read on the moon at mean solar distance it would read there on the average 1.93 calories per square centimeter per minute, we sent up a registering pyrheliometer by balloon to 22,000 meters in 1914 and found there 1.84 calories, which is a very reasonable check.

10. You have exterpolated your thermodynamical discussion of meteorological measurements into the realms of the thin air above 22,000 meters, and into the realms of the sun, which is out of the range of laboratory conditions altogether. Your results widely disagree from those I have just quoted. It seems to me not to matter who makes the curves, whether yourself or another; by the time they get outside the well-observed range of atmospheric data, say 20,000 meters, even though they are sound at the bottom (and this I am not quite sure of), they rank rather as interesting speculations than as having quantitative value.

By authority of the Secretary:

Yours truly,

C. G. Abbot,

Director, Astrophysical Observatory

Professor Frank H. Bigelow,
Solar and Magnetic Observatory,
Pilar, Argentina.

REPLY TO PROFESSOR WILDER

Being much interested in a short article by Professor Wilder, appearing in Science of April 19, on the subject of "*Desmognathus fuscus* (sic)," it occurred to me that a few remarks might not be inappropriate. The object of the nomenclatorial code in zoology, as I assume Professor Wilder recognizes as fully as any other zoologist, is primarily to afford a means of naming the various species of animals. In view of this I think it will be admitted that philological conditions should play a secondary rôle to consistency and permanence. Most zoologists are in favor of ridding nomenclature of the idiosyncrasies continually occurring in language, in order to bring about absolute uniformity so far as may be possible. This tendency can be traced easily. In former times it was the custom, for instance, to begin all specific words founded upon proper names with the capital letter; then, the desirability of uniformity becoming increasingly evident, only specific designations founded upon the names of persons were so written; at the present time, in all parts of the world excepting continental Europe, the custom prevails of beginning all specific names, including the personal, with a small letter. It is now *Omus edwardsi*, for example, and not *Omus Edwardsii*, as originally published, the adoption of the single *i* in all cases to form the genitive ending, being another recently adopted rule formulated in the sole interest of uniformity. All this should horrify the philologist quite as much as the disregarding of irregular Greek genders.

Now in regard to genders, it is considered desirable by many systematists—and their

number is continually increasing—to adopt rules as uniform as that affecting capitalization; that is to say, generic words having a given form of ending should demand a gender ending in the specific word conforming to the general Latin rule, ignoring the accidental exceptions of language. So generic words ending, for instance, in *us, os, ax*, etc., require in every case the masculine form of the specific name, those ending in *a, is, e*, etc., the feminine and those ending in *m* or *n* the neuter. Personally, I should even be in favor of writing *Venus mercenarius,* instead of *Venus mercenaria,* first of all to agree with the uniformity rule mentioned, but also, in this special case, because the goddess of love can not be a clam, and the word *Venus* in *Venus mercenarius* can not therefore stand for the goddess of love, but is merely a word resembling her designation, though masculine for nomenclatorial purposes.

Furthermore, in alluding to Greek genders it should be remembered that when a word derived from the Greek, Arabic or Hottentot, or arbitrarily composed of a pronounceable series of letters, becomes the name of a genus modified by an adjectival Latin specific name, the genus word can no longer be Greek, Arabic or Hottentot, but automatically becomes Latin and should demand gender endings in the specific word in accordance with the most general Latin rules alone. It is only by adopting rules rigidly fixed such as this that nomenclature can be rendered practically stable, and this is an end that all zoologists would rather see than strictly philologic purity, which, conforming to all sorts of linguistic vagaries, would give to it a piebald character certainly very undesirable and inconsistent with uniformity, which is the most essential requisite of any nomenclatorial code.

Finally, it might be added, biology has nothing closely in common with philology. We simply have to use words of some kind to express ideas and name the different forms of animal life, but this language should be invented by biologists for their own ends and not made to conform to the pitiful mixture of contradictions and exceptions constituting actual human language, either ancient or modern.

Thos. L. Casey

Washington, D. C.,
May 11, 1918

OUR NATIONAL FLOWER

To the Editor of Science: In confirmation of the admirable plea for the columbine by Albert A. Hansen (Science, April 12, 1918) may I call attention to a few additional facts regarding its unique fitness to be our national emblem, and the support it has already received? A history of earlier efforts in The National Flower Movement is given by the present writer in the *Transactions of the Massachusetts Horticultural Society*, Part I., 1898; where will also be found a full discussion of the merits of various candidates.

The idea of having our native columbine for national flower occurred independently to several persons during the time of preparation for the Columbian Exposition at Chicago; and in 1895 there was organized the Columbine Association whose object is, by spreading information of its fitness, "to bring about the official adoption of the columbine as the national flower of the United States." The following year a National Flower Convention composed of delegates from the various states of the Union, chosen by their respective governors at the request of Governor Elias Carr of North Carolina, met from the twenty-first to the twenty-third of October at Asheville to decide upon the most suitable flower for our national emblem. With a view to helping future decision it was unanimously

Resolved, That a plant to serve properly the purposes of a national flower should meet the following conditions:

1. It should be a native of the United States, and should grow wild over the greater part of its area.

2. It should bloom on one or more of our national holidays.

3. It should be capable of easy cultivation in any garden.

4. It should not be a weed, or in any way offensive, or harmful to health.

5. It should bear what in the popular sense is called a flower, and should not be merely a foliage plant or one chiefly valued for its fruit.

6. It should lend itself readily to floral decoration by variety and purity of color and distinctiveness of form.

7. The features characteristic of its form should combine such simplicity and gracefulness that, when used conventionally in decorative design, the flower may be readily recognized independently of its color.

8. It should be a flower which has never been used by any other people as their emblem, and not resemble such a flower in general form.

9. It should possess, if possible, patriotic associations plainly connecting it with the best for which our country stands among the nations of the world.

While the convention deemed it inexpedient to make any recommendation of a special flower at that time it was evidently the sense of a majority of the delegates present, as shown by an informal vote, that the columbine, or aquilegia (sometimes known as wild honeysuckle) is the only flower which meets the requirements set forth in the above resolution.

Beside the columbine's qualifications advanced by Mr. Hansen, the following are noteworthy. Short-spurred forms of the flower, native to our Rocky Mountains and to the home of Columbus, resemble so closely a group of doves that the flower's name—like that of the great discoverer, and our national title Columbia—is derived from the Latin *columba*, a dove. Thus, the same flower which rides our mountain storms like an American eagle becomes in quiet valleys a dove-flower symbolizing peace. One of its short-spurred nectaries bears remarkable resemblance to a liberty-cap; those of moderate length are miniature horns of plenty; and the longest are golden trumpets proclaiming Columbia's ideal of liberty, whence comes the peace that makes for plenty, the plenty that makes for power, and the power that makes for peace. A columbine leaf with its many leaflets in organic union, the leader among them having thirteen lobes, aptly recalls that mutual loyalty which the founders of our thirteen original states implied in their motto *e pluribus unum*.

Frederick LeRoy Sargent

Cambridge, Mass.

The article on the above subject in the April 12 number of Science is timely, inasmuch as, if we do not hurry, all the best flowers will be selected ahead of the nation. Even the one Mr. Albert A. Hansen proposes has already been preempted by Colorado.

The *Aquilegia canadensis* is a charming spring flower, well worthy the compliment he pays it, but I will mention a few objections. In the first place, it would be a trespass upon that state's rights to select their flower, especially when there are so many others to choose from. Then its name, *canadensis*, indicates that is was first made known from Canada, which is no part of America, as we wish it to be known, the U. S. A. The chief objection to the wild columbine is that it falls to pieces so readily. This prevents it from being a valuable addition to a bouquet, or for decoration. After the petals have fallen, only the ragged follicles remain. Nor is it extremely common in this part of the country, the specimens I have growing in my garden coming from a start procured with some difficulty.

Some years ago, the goldenrod was proposed for the national flower of America and I have often wished that it might be adopted. There are 47 distinct species of this plant mentioned in Britton and Brown's "Flora," almost as many as the states in the Union. Perhaps one or two more may be discovered to make the number exact. All are of the same color, yellow, like sunshine, symbolic of cheerfulness. The goldenrod belongs to the Composites, the "many in one" family of flowers; and its botanical name, *Solidago*, means to make whole. It is a universal plant in this country, and one species, *Solidago juncea*, blooms from June into November. This is a handsome variety and bears cultivation, as do most of them.

Columbia's flower, the goldenrod, on hill and valley grows;
The gold is for the one who earns, the rod is for her foes.

Katharine Dooris Sharp

London, Ohio

SCIENTIFIC BOOKS

Plants, Seeds and Currents in the West Indies and Azores. By H. B. Guppy. London, 1917.

Although published last year I experienced considerable difficulty in getting a copy of this book, nor have I noticed any reviews of it in American botanical periodicals. Guppy has long been a student of the sea drift, and strand floras as influenced by ocean currents, and in his well-known book "Observations of a Naturalist in the Pacific," published in 1906, he gave an exhaustive study of insular floras and plant dispersal in that region, as well as some interesting but less profitable discussions of the geological eras of the floral history as he conceived them.

The present volume presents the results of similar studies carried out during the period from 1906 to 1914 in the Antillean region and the Azores. It is just the sort of a book that we have been waiting and wishing for, and in addition to the wide general audience it makes an especial appeal to those who are interested in the geological history of the Antillean region and the relations of the floras and faunas of its perimeters. It undoubtedly contributes toward a solution of paleontological problems and enables them to be viewed from the various angles necessary to their ultimate proof or disproof.

One conclusion of especial interest, in view of the manner in which some paleontologists subscribe to isostacy and think therefore that the permanence of ocean basins is proven, may be illustrated by the following quotation from the preface: "The great lesson that I have learned from the numerous difficult distribution-problems presented in the West Indian region is that one can no longer fight shy of accepting in principle the conclusions relating to past changes in the arrangement of land and water in the Caribbean area, which have long been formulated by English and American geologists and zoologists. The witness of the living plant is often quite as insistent as the testimony of the rocks." He might have added that this statement loses no force from a consideration of the fossil plants.

For the plant geographer every chapter is packed with information, and the fact that the geological history of both the land and its floras is not ignored gives an outlook and a basis for deduction that are altogether admirable. Without attempting an elaborate abstract or analysis of Guppy's results I wish to mention several aspects of the work that are of especial interest to students of earth history.

Chapter II. is a fine summary of personal observations and the scattered and inaccessible records in the older literature going back to the days of Clusius (1605), of West Indian drift on European shores. This is exceedingly interesting, not only as an illustration of the unsuspected variety of plants represented and distances traversed, but also of the relative frequency of such trans-Atlantic journeys. These may be given point by the fact that in the Hebrides, Orkneys, Shetland and Faroe islands as well as in Scandinavia, snuff, tinder and match boxes made from *Entada* seeds derived from the stranded drift from tropical America have always been highly prized by the natives. Mr. Guppy is apparently unaware that similar *Entada* seeds have reached a resting place in some of the Scandinavian peats after a similar voyage in the late Pleistocene. I mention this, not because it is of any especial importance in the present connection, but as a fact of added interest. Many of these stranded ocean waifs, such as the seeds of *Guilandina*, *Erythrina* and *Ipomœa tuberosa*, have a mystical or superstitious value and are often handed down from generation to generation as charms among these out-of-the-way peoples.

Most seeds after such a long voyage have lost their germinative capacity, even were not the European climate prohibitive. Some, however, retain their vitality, and this has been demonstrated experimentally in the case of *Entada*, *Guilandina* and *Mucuna*, and is conceivable in the case of *Sapindus*, *Ipomœa*, *Dioclea* and *Erythrina*, so that in the early Tertiary, when the climate was much more uniform and mild than it is at the present time in the far north, it is conceivable that certain tropical American forms may have reached Europe in this way.

A highly instructive chapter is that devoted to the similarity between the strandflora of

West Africa and tropical America. This has long been known to botanists and often discussed, as, for example, by Schimper and Engler. The latter is inclined to insist that the present distribution demands a land connection, and this hypothesis is heightened by the usual assumption of such a land bridge by paleogeographers based on the distribution of littoral faunas, the absence of marine Tertiary deposits on the facing coasts, the evidence of the foundering of earth blocks in certain areas, and the absence of Mediterranean elements in the early Tertiary marine fauna of Patagonia.

If the community of floras on the two sides of the tropical Atlantic was entirely confined to strand types the conclusion would be inevitable that this was due entirely to the action of ocean currents, but such is not the case, nor are these features confined to the Recent floras, for in the Tertiary floras of our Gulf states a number of genera common to West Africa and tropical America had already made their appearance.

An important conclusion of Guppy's is that the sphere of influence of the ocean current in determining plant distribution between the Oriental and Occidental tropics is limited, and that their action leaves the main facts of general distribution unconfused. In the comparison of the floras of the West African and American tropical littoral the most direct journey, namely from the former to the latter via the Main Equatorial current, requires that a fruit or seed will float unharmed for from two to three months. The results for 53 species are embodied in a table showing that 6 mangrove, 7 estuary and riverside, and 19 beach plants, or 60 per cent., are found in both regions, and of these 88 per cent. show experimentally that they possess the required buoyancy and resistance to enable them to make such a journey.

While the evidence is only negative it may be noted that the oldest known fossil occurrences of the genera *Rhizophora, Avicennia, Laguncularia, Canavalia, Dodonæa, Chrysobalanus, Conocarpus* and *Carapa* are American. Guppy's discussion is eminently open-minded and shows conclusively that most of the common species have the necessary powers of resistance, while only 24 per cent. of the strand plants confined to the American tropics possess fruits or seeds capable of making the trans-Atlantic trip. I am, however, inclined to dissent from his conclusion, at least as regards its application during the Tertiary, namely, that since the Main Equatorial current offers the easiest avenue of distribution, this distribution has been from east to west. The more general conclusions derived from a study of geological distribution point in many cases to an original distribution from west to east. The fact that genera like *Moschoxylon* (Meliaceæ) with about three score existing species in tropical America and West Africa has fossil species in the lower Miocene of Chile and Colombia indicates that other explanations than dispersal by ocean currents are involved, and the distribution of the family Humiriaceæ is another illustration of the same kind. Many such instances are given in a recent discussion of fossil floras.[1]

This is not the place, however, to elaborate this thesis since the distribution of the recent floras of the two regions is fairly well known and Guppy's work concerns only the littoral species and in discussing these he is never dogmatic.

The chapter devoted to the current connections in the Southern Hemisphere, based largely on records of bottles and wreckage, is also exceedingly interesting, but the time involved in such journeys between these outlying land masses is too great to be a large factor in the curious similarities of elements in antipodean floras, which are really results of geological history. Moreover there is rather definite evidence of land connection, especially the early Tertiary connection of Graham Land and Patagonia, at which time *Fagus* and *Nothofagus*, as well as other northern derived types appear to have invaded Patagonia and Chile from the Antarctic.

For shorter distances currents may have been important factors, *e. g.*, tropical Australia

[1] U. S. Geol. Survey Professional Paper 91, pp. 72–140, 1916.

and tropical East Africa have reciprocating currents, while the south coast of Australia receives drift from South Africa and southern South America. Similarly southeastern Australian drift would tend to reach the north end of New Zealand. If the data were only sufficient for the construction of accurate paleogeographical maps for those times of land extension during the Tertiary and Quaternary and if the ocean currents could then be plotted upon these, doubtless much light would be shed on many anomalies of distribution.

Work like that of Guppy, interesting and important as it undoubtedly is, can hardly be said to furnish more than analogies and a basis for theory, since the distribution of most of the orders of plants was a much more ancient process, and unless we are prepared to subscribe to similar continental outlines, climates and ocean currents during the Tertiary, all three assumptions which are negatived by what we already know of geological history, we have many other factors than are furnished by existing conditions which must be taken into account.

The chapters headed Differentiation and Distribution are eminently sound in principle and should give plant geographers much food for thought. It is a great pity that in this connection the author seems to be unfamiliar with considerable recent American literature on this subject.

A special chapter is devoted to the distribution of *Sphagnum* and *Carex*, and the Azores occupy the three concluding chapters, while an appendix contains over fifty additional pages of valuable matter.

The book is well written and well printed and is a mine of information which is illuminated throughout with ideas, and it should find a place in every well-equipped library.

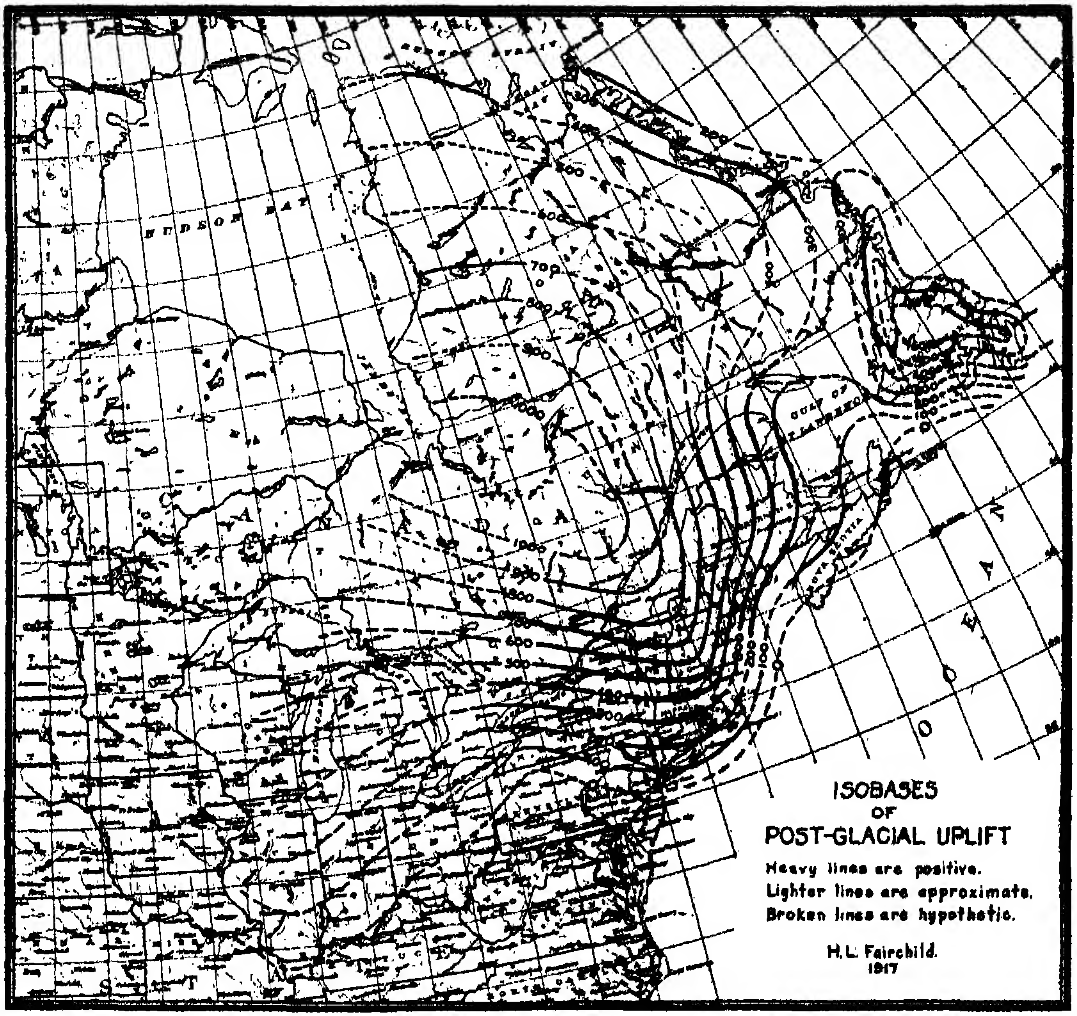
EDWARD W. BERRY
JOHNS HOPKINS UNIVERSITY,
BALTIMORE

SPECIAL ARTICLES

POST-GLACIAL CONTINENTAL UPLIFT

THE rise and fall of great areas of the earth's surface (diastrophism) is one of the most certain facts of human observation. Isostacy, the general equilibrium or balancing of pressures within the earth's "crust," is recognized as a fundamental principle of geophysics. The crust of the earth is sensitive to unbalanced pressures, the loading and unloading of different areas. It is, therefore, reasonable to suppose that the weighting of large areas of northern lands in Pleistocene time by the accumulation of vast continental glaciers, one or two miles in depth, would produce subsidence; and that the return of the ice caps to the sea would cause uprising of the depressed areas.

Whatever may be the opinion of the student of geophysics regarding the effect of the Pleistocene ice caps on diastrophic land movement, yet the fact is certain that the area covered by the latest North American ice sheet, the Labradorian glacier, stood much beneath its present position, relative to sea level, when the ice sheet melted off; and that a recent slow uplift has brought the land to its present attitude. The proof of this Post-Glacial uplift is the occurrence of many high-level beaches and sandplains facing the open sea, and extending far up the valleys in Canada, New England and New York, with the occurrence of abundant marine fossils hundreds of feet above the ocean. These facts have been recognized for nearly a century, and a great number of observations are on record in Canadian and American geological literature. Yet up to the present time the full vertical amount of submergence, or the subsequent uplift, and the extent or limits of the affected area have not been determined beyond dispute. The total amount of the down-and-up movement has nearly always been underestimated, for the reason that the conspicuous or more evident marine features are of inferior and later levels, while the initial and summit shore features are commonly weak and unobtrusive, or they lie so far inland and are so detached as to be unrecognized, or their origin and relationship misinterpreted; usually being referred to glacial agency. Yet the summit or initial level at any locality is the one critical and essential element in the diastrophic problem.



The determination in recent years of the upraised marine plane throughout the Hudson-Champlain and Connecticut valleys afforded a good base line for more extended exploration.[1] During the summer of 1917, with financial aid from the research fund of the American Association for the Advancement of Science, the writer has been able to determine with precision, or with close approximation, the amount of Post-Glacial land uplift over New England and eastern Canada, as shown by the accompanying map.

On the small scale the map is, of course, somewhat generalized, but it is confidently believed to fairly represent the truth. The broken

[1] "Pleistocene Marine Submergence of the Connecticut and Hudson Valleys," *Bull. Geol. Soc. Amer.*, Vol. 25, 1914, pp. 219–242.

"Pleistocene Uplift of New York and Adjacent Territory," *Bull. Geol. Soc. Amer.*, Vol. 27, 1916, pp. 235–262.

"Post-Glacial Marine Waters in Vermont," Report of Vermont State Geologist for 1915–16, pp. 1–41, 1917.

"Post-Glacial Submergence of Long Island," *Bull. Geol. Soc. Amer.*, Vol. 28, 1917, pp. 279–308.

"Post-Glacial Features of the Upper Hudson Valley," New York State Museum, Bull. No. 195, 1917.

lines are entirely hypothetic only in the Mississippi Valley, where there was probably some land uplift during the closing glacial epoch, the time of the Labradorian glacier. Except in the district west of Indiana and Michigan the map is intended to show only the Post-Wisconsin uplift, or the rise of the continent subsequent to the removal of the latest (Labradorian) ice sheet.

For Labrador and Newfoundland reliance is placed on the published figures of R. A. Daly, with some help from unpublished data of A. P. Coleman and J. B. Tyrrell.

Shoreline or beach features, bars and cliffs, are relatively uncommon at all stages of the uplifting, and rare at the primitive or summit plane of the sea-level waters, especially in far inland and secluded waters. For the above reason the main reliance in this study, especially when covering large territory in limited time, has not been placed on the uncertain open shore phenomena, but on the sure occurrence of deltas built by rivers debouching into the static waters. To avoid doubt or cavil as to glacial (ice-impounded) waters the main dependence has been on the deltas of streams with southward flow, or with flow directed away from the receding ice margin. To determine the true marine plane discrimination must be made between the sand plains which represent the initial sea level and the aggraded, coarse, upstream plains in the one hand, and the finer, submerged, downstream plains on the other hand. Where the valley stream deltas are heavy, with great horizontal extent and large vertical range, making more difficult the location of the primitive water plane, close determination of the latter is made by study of the deposits of small streams and other static-water features along the adjacent valley walls. Of course, the beach phenomena are utilized wherever possible, and especially on exposed coasts. In the extended paper, noted below, will be found a description of field methods, and a discussion of criteria for distinguishing marine features.

The map reveals strikingly the direct relation of the ice sheet to the diastrophic land movement; the area of uplift being the area of glaciation, and the amount of uplift being, apparently, in proportion to the relative thickness of the spreading ice cap. The map also shows the effect of land and sea on the flow and reach of the ice sheet. The ice deployed widely on the land, but was inhibited by the sea; thus producing more rapid flow and steeper gradients along the radii toward the nearer shores.

An independent ice cap over Newfoundland is indicated by the large local uplift.

The map also suggests that the correct name for this latest ice cap is not Labradorian but Quebecan; since the center of uplift, and presumedly the center of snow accumulation, lies between Quebec City and James Bay, while Labrador, proper, is only the narrow border of the so-called "Labrador peninsula."

For the details in this study, in both methods and results; for the description of features in western New England, Maine, St. Lawrence and Ottawa valleys, Gaspé peninsula, New Brunswick, Nova Scotia, Labrador and Newfoundland; and discussion of the possible effects of any change in ocean level, the reader is referred to the detailed paper, published in the *Bulletin* of the Geological Society of America, Vol. 29.

H. L. FAIRCHILD

DEPARTMENT OF GEOLOGY,
UNIVERSITY OF ROCHESTER

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting was held in the hall of the society on Independence Square on April 18, 19 and 20. On the evening of April 19 there was a reception at the hall of the Historical Society of Pennsylvania, when Lieutenant Colonel Robert Andrews Millikan, Ph.D., Sc.D., of the department of science and research of the Council of National Defense spoke on "Science in relation to the war." At the annual dinner given at the University Club on the evening of April 20, the list of toasts was as follows:

"The memory of Franklin": Hon. David Jayne Hill.

"Our learned societies": George Ellery Hale.

"Our universities": Ethelbert D. Warfield.

"The American Philosophical Society": John C. DaCosta.

New members were elected as follows:

Residents in the United States

Henry Andrews Bumstead, A.B., Ph.D., New Haven.
Philip Powell Calvert, Ph.D., Philadelphia.
Clarence Griffin Child, Ph.D., L.H.D., Philadelphia.
William T. Councilman, A.M., M.D., LL.D., Boston.
Victor George Heiser, M.D., New York.
Herbert C. Hoover, B.A., LL.D., Washington.
Aleš Hrdlička, M.D., Washington.
Gilbert Newton Lewis, A.M., Ph.D., Berkeley, Calif.
Theodore Lyman, Ph.D., Cambridge.
J. Percy Moore, Media, Pa.
Louis Valentine Pirsson, M.A., New Haven.
George Harrison Shull, B.S., Ph.D., Princeton.
Joseph Swain, B.L., M.S., LL.D., Swarthmore, Pa.
William Roscoe Thayer, A.M., LL.D., Litt.D., L.H.D., Cambridge
Samuel Wendell Williston, A.M., M.D., Ph.D., Sc.D., Chicago.

Foreign Residents

Joseph Jacques Cesaire Joffre, Paris
Paul Painlevé, Paris.
Raymond Poincaré, Paris.

SCIENTIFIC PROGRAM

Thursday Afternoon, April 18; William B. Scott, D.Sc., LL.D., president, in the chair

Control of prices of food under Queen Elizabeth: E. P. Cheyney, A.M., LL.D., University of Pennsylvania. The five years from 1594 to 1598 were a period of great scarcity and high prices of all food products in England. The average price of wheat, transformed into modern values, was for months at a time above $7 a bushel, and in some places and at certain times, especially in the year 1596, it rose to $15 and even $18 a bushel. Rye, oats and barley were hardly cheaper and meats and other food rose in proportion. There was much privation and disorder. The government took the following steps to overcome the difficulty: (1) One set of provisions was directed toward better distribution of what food was in England. (2) Another set of provisions was directed toward increasing the available supply. (3) It is noticeable that the government did not establish a legal price; no relation was established between the price of grain and the price of flour; no substitutes were provided for. (4) The government, town authorities and the rural gentry were constantly in fear of popular uprisings, and there were several threatening movements which were vigorously punished by the government. (5) No satisfactory method of controlling the supply and price of food was worked out at this time, and the suffering was only alleviated by better crops, heavy taxation for the poor, and the cessation of the war.

Control of commerce in war time: William E. Lingelbach, professor of modern European history, University of Pennsylvania.

The influence of Russian political parties on domestic and international questions: Alexander Petrunkevitch, Ph.D., professor of zoology, Yale University.

The relations of French and American thought in the eighteenth and nineteenth centuries: Albert Schinz, A.M., Ph.D., professor of French literature, Smith College, Northampton, Mass.

Problems of war finance: Thomas S. Adams, Ph.D., professor of political economy, Yale University.

Control of railroads of the United States: Emory R. Johnson, Sc.D., professor of transportation and commerce, University of Pennsylvania.

The sanitation of camps: Colonel Frederick F. Russell, Medical Corps, U. S. A.

Surgical shock: William T. Porter, M.D., LL.D., professor of comparative physiology, Harvard University.

Friday Morning, April 19; J. G. Rosengarten, LL.D., Vice-president, in the Chair

History of the study of Greek vase painting: Stephen B. Luce, curator of Greek antiquities, Museum of the University of Pennsylvania.

The art of George Catlin: Edwin Swift Balch, A.B., of Philadelphia.

Typewriter keyboards; an inquiry for some rational ones: Charles R. Lanman, Ph.D., LL.D., professor of Sanskrit, Harvard University.

Changing of sex ratio in the rat: Helen D. King, associate professor of embryology, Wistar Institute, Philadelphia. This paper gave the results of a series of inbreeding experiments on the albino rat that were made to determine: (1) whether inbreeding increases the number of male offspring, as maintained by Carl Düsing; (2) whether the sex ratio can be altered by selection. The data summarized cover twenty-five generations of inbred rats, comprising 25,452 individuals. Accepting the current view that the spermatozoa are of two kinds, one "male-producing" and the other "female-producing," it is possible to explain the altered sex ratios in the two series by assuming that, in the A series, selection preserved those females for breeding in which the ova had an inherited tendency to attract spermatozoa that were "male-producing"; among the offspring, therefore, there was an excess of males (122.3

males to 100 females). In the B series, on the other hand, selection preserved the females in which the ova tended to attract "female-producing" spermatozoa, consequently the series showed an excess of females (81.8 males to 100 females). The results indicate that it may be possible to swing the sex ratio in a desired direction, even though we are unable to determine the ultimate cause of sex itself.

The Naiades of the upper Tennessee drainage: ARNOLD E. ORTMANN, Ph.D., Sc.D., professor of physical geography, University of Pittsburgh. The upper Tennessee region (above Chattanooga) has long been famous for the great number of mussel species found in its water. It has been studied by various collectors for nearly one hundred years; but up to the present time great confusion prevailed as to the species found in this region, and their affinities. The present writer made it his chief object during four summers, to collect the shells of this drainage together with the former; this is imperative for a proper understanding of all Nayad shells. It was found that the material collected included practically all species previously reported; it was possible to ascertain, in every case, the proper systematic position of each form, and, finally, the geographical distribution of each form, within this area, was ascertained, and was correlated with the geographical range elsewhere. Thus, the present paper represents a complete account, a synopsis, of everything known hitherto about the upper Tennessee mussels and with numerous additional observations not known previously.

A new type of insect larva: WILLIAM MORTON WHEELER, Ph.D., Sc.D., professor of economic entomology, Bussey Institution, Harvard University. The first larval stage ("trophidium") of two African ants, *Pachysima æthiops* Smith and *P. latifrons* Emery, proves to be unlike the larva of any known Formicid or, in fact, of any known insect, in possessing peculiar exudate organs ("exudatoria") surrounding the mouth. These organs are very primitive adipose glands which evidently furnish a liquid agreeable to the worker ants and are very similar to the exudate organs of ant guests (myrmecophiles) and of termites and their guests (termitophiles). The salivary glands and fatbody have a similar function in other ant larvæ. The relations between ants and their larvæ therefore involve mutualistic or reciprocal feeding and this accounts for the development of the colony both ontogenetically and phylogenetically and therefore for the social habit of the Formicidæ. Myrmecophily, trophobiosis, "social parasitism" among the ants themselves and the relations of ants to plants with extrafloral nectaries and food bodies all depend on essentially the same conditions. Similar conclusions are reached in regard to the origin and meaning of the social habit among social wasps, some bees and termites.

A critical survey of the sense of hearing in fishes: GEORGE H. PARKER, Sc.D., professor of zoology, Harvard University. That fishes could hear was maintained by most of the naturalists of antiquity, such as Aristotle and Pliny. This was also the opinion of such masters of the art of fishing as Isaac Walton and of such students of fish anatomy as John Hunter. In fact this was the universal view of the function of the ears in fish till 1878 when von Cyon declared that their only function was to keep the fish in equilibrium. This opinion was supported by Kreidl, who in 1895 attempted to show that when fishes did respond to sounds they responded through the organs of touch and not through the ear. Following Kreidl's work appeared a series of researches some of which supported the opinion that fishes did not respond to sounds at all while others tended to show that fishes did respond to sounds and that this response was mediated by the ear as well as by the skin. One of the most sensitive fishes in this respect is the common catfish *Amiurus*. Tests on this fish were carried out by Parker and Van Heusen with the following results. In catfishes in which the ears had been destroyed, the skin was found sensitive to the dropping of water, to water currents, to a slow vibratory movement of the whole body of water, to the impact of a leaden ball on the slate wall of the aquarium, but not to a whistle blown in the air. In catfishes in which the skin had been rendered insensitive, the ear was stimulated by a slow vibratory movement of the whole body of water, by the impact of the leaden ball, and by a whistle blown in the air, but not by the dropping of water nor by currents of water. To test more fully the effects of sounds, catfishes were subjected to the tones from a telephone contained in a tight rubber bag and submerged in the water of the aquarium. When the ears were destroyed, the catfishes responded to vibrations 43 to 172 per second but not to vibrations 344 to 2,752. When the skin was rendered insensitive, they responded to vibrations 43 to 688 but not to vibrations 1,376 to 2,753. Catfishes respond, therefore, to a range of low vibrations less freely through the skin, more freely through the ear. Hence they have unquestionable powers of hearing.

The perfecting principle: L. H. Bailey, LL.D., late professor of horticulture, Cornell University.

Medicinal plants—present and future supplies: Henry Kraemer, Ph.D., head of department of pharmacology, University of Michigan.

Parasitism among the red algæ: William A. Setchell, Ph.D., professor of botany in the University of California. Parasites among the members of the Rhodophyceæ, or Red Algæ, are becoming more and more known. The author has been paying special attention to these parasites for some years. Of some 51 species, old or new, known to be wholly or partially parasitic, 39 are on plants of the same family of Red Algæ, 8 others are on Red Algæ not of the same family but with some on hosts fairly nearly related; while only 4 are parasitic on hosts belonging to other groups (brown or green algæ). These facts seem significant as to the origin of these parasites. The epiphytic red algæ often penetrate the host plant which is commonly also one of the Red Algæ, but also may be either brown or green. Some light may be thrown on the origin of red parasites, particularly of those parasitic on close relatives by the behavior of the tetrasporangia of *Agardhiella tenera.* As described by Osterhout in 1896 the zonate tetrasporangia germinate as a whole even after division into tetraspores, and produce dwarf unbranched plantlets which penetrate the tissues of the parent plant by basally produced rhizoids. The plantlets produced are largely antheridial, but some are cystocarpic and some even tetrasporic. Such mutations as these plantlets of *Agardhiella* seem to represent, accompanied by a greater or less degree of chlorosis, go far toward indicating a possible origin of these parasites on closely related hosts.

Friday Afternoon, April 19; Albert A. Michelson, Ph.D., Sc.D., LL.D., F.R.S., Vice-president, in the Chair

The genus Galera in North America, with preliminary notes of some new species of Agarics: George F. Atkinson, Ph.D., professor of botany, Cornell University. *Galerula* is a genus of yellow-spored Agaricaceæ including small plants or those of medium size, but slender in form, and fragile. The species have no claim to rank or economic importance, while their ecological rôle as saprophytes is not large owing to the comparatively small number of individuals. Many species are usually associated with mosses on logs or ground in the woods or swamps. A number of species occur on dung heaps or in recently manured grass lands. The larger number of species are some shade of yellow, or tawny, or ochraceous. In taxonomic works the genus is usually divided into sections according to external characters and ecological relations. By this method the species are not grouped according to their real affinities, and in a few cases forms not closely related are assembled under a single specific name. A high degree of internal structural differentiation has taken place in the evolution of the species. In the present study this vantage point has been employed to group the species into sections more nearly in accord with their true relationships. Between 50 and 60 species are recognized in North America.

Temperature, imbibition and growth: D. T. MacDougal, Ph.D., LL.D., director of the department of botanical research, Carnegie Institution of Washington. The effects of temperature upon swelling of biocolloids consisting of agar, and proteins have been previously described. With these results were given measurements of the swelling of sections of *Opuntia* already in a turgid condition with their imbibition capacity nearly satisfied, and not in a growing condition. Special tests were arranged by which the effect of changes in temperature upon the swelling of sections of growing cell-masses and upon the growth of similar masses should be determined. Elongation by growth of the stems in question was at the rate of 5.2 mm. daily at 16°–18° C. and 11–17 mm. daily at 30°–32° C. The increase amounted to a doubling, more or less, for a rise of 10° C. The swelling in transverse sections of similar material was 4.9 per cent. at 17°–19° C. and 7.5 per cent. at 30°–31° C. in distilled water: and 4.9 per cent. at the lower temperature in acidified potassium nitrate and 9.5 per cent. at the higher temperature. The increase by swelling transversely was therefore slightly less than double with a fair inference that it would have been greater in the axis of elongation or growth. It is to be seen therefore that in the elongation of the vegetative axes of plants, the temperature effect is a very complex one, and that the accelerating effect of rising temperature may be primarily an increase in absorption capacity by altered metabolism including lessened accumulations of acids.

Variation in blueberry hybrids: Frederick V. Coville, curator of the U. S. National Herbarium, Department of Agriculture, Washington, D. C.

Organization, reproduction and heredity in Pediastrum: Robert A. Harper, Ph.D., professor of botany, Columbia University.

The potentials of certain magnetised bodies (illustrated by lantern slides): LOUIS A. BAUER, Ph.D., D.Sc., director of the department of terrestrial magnetism, Carnegie Institution of Washington. The author has had occasion in connection with various problems to establish, in a convenient form, the mathematical expressions for the potentials and field-components of certain magnetized bodies of revolution, such as, for example, ellipsoids of revolution and elliptic homeoids. The expressions usually found in treatises either stop at those for the problem of gravitation, or apply only to special cases, or they are not given in the most elegant or convenient form possible for mapping out readily the magnetic field surrounding the bodies. Not infrequently, moreover, the published expressions are found to contain errors of one kind or another.

Development of magnetic susceptibility in manganese steel by prolonged heat treatment: CHARLES FRANCIS BRUSH, Ph.D., ScD., LL.D., of Cleveland.

Accelerometers: N. W. AKIMOFF, of Philadelphia.

Luminescence of radium salts: D. H. KABAKJIAN, assistant professor of physics, University of Pennsylvania, and E. KARRER, of Philadelphia. All radium salts luminesce in the dark at ordinary room temperature. It has been found that when a radium compound is heated to a critical temperature it will almost completely lose its luminosity while at this temperature, but when it is again cooled to room temperature it will acquire a luminosity which is many times (from ten to fifty times for radium bromide, barium bromide) its original luminosity. This property of radium compounds has been investigated as regards the following points: (1) Relation between luminosity and the maximum and minimum temperatures to which the salts have been exposed; (2) decay of the acquired luminosity with time; (3) degree of recovery of luminosity after decay by reheating; (4) relation between luminosity and chemical composition of the salt. The phenomena described in the paper can probably be explained if it be assumed that with the greater molecular freedom imparted to the salt at the higher temperatures certain groupings of molecules are formed which are stable at the higher temperatures but unstable at the ordinary room temperatures. The breaking down of these groups by the action of alpha, beta, gamma rays produces the luminescence. These groupings would correspond to the so-called "active centers" which are postulated by Rutherford in his discussion of luminescence of zinc sulphide, but differ essentially from them by the fact that these can be destroyed and reformed over and over again by heating the compound, whereas the active centers in zinc sulphide, once destroyed, can not be recovered by any simple process.

Saturday Morning, April 20; George Ellery Hale, Ph.D., Sc.D., LL.D., F.R.S., Vice-president, in the Chair

Motions in the stellar systems Struve 1836 and Struve 208: ERIC DOOLITTLE, professor of astronomy, University of Pennsylvania. Any double star in our catalogues may be a system of two suns, which are revolving about one another under the action of their gravitation, or their apparent connection may be only an accidental; one star may be immeasurably farther away than the other and they may only appear to be near together because they are in the same direction from us. In the latter case, measures will in time show that the one sun is drifting past the other in a straight line; in the former, the one will move about the other in an elliptic orbit. The two cases examined present especial difficulty because in each case the companion is moving directly toward the principal star in a straight line. Originally the stars were widely separated; now they are close together and are only visible as a double star in the largest telescopes. The path may be an ellipse, in which case we view it almost edgewise, and if this is the case the motion of the companion will be apparently reversed as it passes about its orbit and the motion will soon become very rapid. Observations of such systems should be secured now, while the companion is at a critical part of its path. It was found that each of the two systems examined were true physical systems and that the motion was in each case orbital.

The number of the spiral nebulæ: H. D. CURTIS, astronomer, Lick Observatory, Mt. Hamilton, Calif.

Soldiers' and sailors' insurance: SAMUEL McCUNE LINDSAY, Ph.D., LL.D., professor of social legislation, Columbia University, New York.

Italy in the Triple Alliance: WILLIAM ROSCOE THAYER, Litt.D., L.H.D., LL.D., Cambridge, Mass.

Ballistic experiments by a new (?) method: ARTHUR GORDON WEBSTER, Sc.D., LL.D., professor of physics, Clark University, Worcester, and MILDRED ALLEN.

Some considerations on the ballistics of a gun of seventy-five miles' range: ARTHUR GORDON WEBSTER, Sc.D., LL.D., professor of physics, Clark University, Worcester.

The relation of deposits of iron and coal to the great war: William H. Hobbs, Ph.D., Sc.D., professor of geology, University of Michigan.

The peculiar geographical features of northeastern France and their bearing on the war: William Morris Davis, Sc.D., Ph.D., professor emeritus of geology, Harvard University. The strata of the so-called Paris basin lie nested in one another, like a series of broad and shallow platters, the largest one beneath, the smallest one above, but the edges of all of them reaching to about the same altitude, except that the less resistant layers have been worn down somewhat lower than the more resistant ones. As a result, the more resistant layers rise in upland belts of moderate altitude above the intermediate depressions, and both the uplands and the depressions are arranged in concentric arcs around Paris as a center. Eight of these upland belts may be counted in northeastern France, where they dominate the topography. The arrangement of the rivers with respect to the uplands is varied and peculiar. The local features between Verdun on the Meuse and Lunéville on the Meurthe are best understood when described in terms of the upland belts, the depressions and the river valleys.

Rig-veda repetitions: Maurice Bloomfield, Ph.D., LL.D., professor of Sanskrit and comparative philology, Johns Hopkins University.

The Babylonian origin of the Jewish method of slaughter: Paul Haupt, Ph.D., LL.D., professor of Semitic languages, Johns Hopkins University.

Saturday Afternoon, April 20; William B. Scott, D.Sc., LL.D., president, in the Chair

Symposium on food problems in relation to war:

Introductory remarks: Alonzo E. Taylor, M.D., professor of physiological chemistry, University of Pennsylvania.

Physiological effects of prolonged reduced diet on twenty-five men: Francis G. Benedict, Ph.D., Sc.D., director of the nutrition laboratory of the Carnegie Institution of Washington. The possibility of facing stringent food shortage made it desirable to study with the greatest accuracy the physiological effects of a prolonged reduced ration upon a group of healthy young men. Twenty-five men in two squads, volunteers from the International Y. M. C. A. College in Springfield, Massachusetts, were placed upon a reduced ration, approximately one half the number of calories, and at the end of about two months had lost 10 per cent. of their body weight. From there on the calories were adjusted to hold the weight at a constant level. A long series of measurements of the basal metabolism, the neuro-muscular processes, strength tests, etc., as well as a careful clinical examination, were repeated from day to day. The men showed remarkable stamina in the face of the reduced ration, carried out all of their activities, academic and physical, in connection with their college life, and, aside from obvious degree of emaciation, presented no unusual picture. A marked reduction in calories in the intake was effected.

Food conservation from the standpoint of the chemistry of nutrition: Henry C. Sherman, Ph.D., professor of food chemistry, Columbia University, New York City.

Some economic aspects of the American food supply: J. Russell Smith, Ph.D., professor of industry, Wharton School of Finance and Commerce, University of Pennsylvania. One of the first acts of the government with regard to the bread supply was to interfere with the law of supply and demand by guaranteeing increased home consumption and reduced home production. Despite innumerable reports that maximum price fixing had been unsatisfactory in Europe, we tried it. As one of the first big steps in the United States we reduced the maximum price of wheat at a time when more wheat was needed. We also fixed a minimum price for the 1918 crop lower by a dollar than the price prevailing in the spring of 1917. The American farmer quietly but effectively made his answer. The government, through the Department of Agriculture, called for planting of 47,337,000 acres of winter wheat, and it got 11 per cent. less than this, or 42,170,000, almost exactly the amount sown in 1914. Probably the worst part of this wheat price fixing is that it resulted in a destructive price ration. The high prices of meat pushed the price of corn to such a figure that in many parts of the country it was cheaper to feed the pigs on wheat and rye than on corn, and you may depend upon it many of these four-footed brethren got the breadstuff. In some parts of New York state wheat was 40 to 50 cents a bushel higher than corn. The production of such a condition by legislation as our Congress brought about is not to be called food conservation. It is food destruction. As an outraged citizen I protest against legislation that makes me eat corn and makes the pig eat wheat. If I were a pro-German I would secretly applaud it.

Food control and food conservation in the United States army: John R. Murlin, Major, Sanitary Corps, N. A.

Arthur W. Goodspeed,
Secretary

SCIENCE

FRIDAY, JUNE 28, 1918

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

A SURVEY OF AMERICAN BIOLOGICAL CHEMICAL LITERATURE[1]

ABOUT a year ago Sparks and Noyes[2] prepared a census of the periodical literature of chemistry published in the United States. They selected for their study the five American chemical journals:

American Chemical Journal
Journal of the American Chemical Society
Journal of Biological Chemistry
Journal of Industrial and Engineering Chemistry
Journal of Physical Chemistry

This study showed that during the five-year period, 1909–1910 to 1914–1915, the *Journal of Biological Chemistry* gained 150 per cent. in the number of published pages; the *Journal of Industrial and Engineering Chemistry,* 78 per cent.; the *Journal of the American Chemical Society,* 88 per cent.; while the *Journal of Physical Chemistry* showed a loss in published pages of only 2 per cent. (*The American Chemical Journal* was merged with the *Journal of the American Chemical Society* in 1914).

With this study as a model and an incentive, the writer has made a somewhat similar investigation of the biological-chemical literature during the period 1907–1916. The question as to what properly belongs under the heading biological chemistry is probably open to discussion. It seems fair, however, to accept the decision of the men who are in charge of the various sections of the Biological Chemical division of *Chemical Abstracts.* All papers which are found in

1 This study was presented before the Second Annual Conference of Biological Chemists, held at the Chemist Club, New York City, December 31, 1917.

2 Sparks, Marion E., and Noyes, W. A., SCIENCE, 1917, 45, 168 (February 16).

this division have been considered in this study.[3]

The first indication of the increased interest in biological research may be found in the large number of publications which have been founded and successfully continued during this period. The principal periodicals published prior to 1907 are given in Table I. The date indicates the year of the first publication.

TABLE I

Publications of Biological Chemical Interest Prior to 1907

American Journal of Medical Sciences	1827
Journal of the American Medical Association	1883
Science	1883
Journal of Experimental Medicine	1896
Journal of Medical Research	1896
American Journal of Physiology	1898
Biological Bulletin	1899
American Journal of Anatomy	1901
Journal of Infectious Diseases	1904
Journal of Experimental Zoology	1904
Journal of Biological Chemistry	1905
Anatomical Record	1906

Those journals founded during the period 1907–1916 are given in Table II.

TABLE II

Periodicals of Biological Interest Founded During the Period 1907–1916

Chemical Abstracts	1907
Archives of Internal Medicine	1908
Journal of Pharmacology and Experimental Therapeutics	1909
Biochemical Bulletin	1911
American Journal of Diseases of Children	1911
Journal of Agricultural Research	1913
American Journal of Tropical Diseases	1913
Journal of Laboratory and Clinical Medicine	1915
Journal of Parasitology	1915
Journal of the Association of Official Agricultural Chemists	1915
Journal of Cancer Research	1916
Journal of Bacteriology	1916
Journal of Immunology	1916
Quarterly Cumulative Index to Current Medical Literature	1916
American Journal of Syphilis	1917
Abstracts of Bacteriology	1917
American Review of Tuberculosis	1917
Journal of Urology	1917

[3] It should be remarked in this connection that chemistry is only one of the sciences which have been used in the study of biological phenomena. A similar study might be made for each of the other sciences, especially physics.

The number of journals which have sprung into existence since 1914 is very noticeable. Many of these probably owe their existence, in part at least, to the fact that publication in German magazines was cut off by the war. It is to be hoped that they may survive after the war, when many scientific investigators will again be tempted to publish in German.

Special attention should be directed to the two abstract journals. *Chemical Abstracts* is by far the most complete abstract journal published in any language. It covers nearly 700 periodicals (671 titles are given in the 1915 list; many have been added since then, as the 1917 list, shortly to appear, will show. Still others are covered through other abstract journals, about a dozen of which are regularly checked). The *Biological Abstracts*, so well organized by Professor Gies, and carefully edited by his staff, are especially complete. Very few, if any articles of biological interest are missing. The fact that about 10,000 copies are in circulation must add to the value of American scientific research. *Abstracts of Bacteriology* covers a similar field for the bacteriologist and appears to be equally well organized. And finally, the *Cumulative Index of Current Medical Literature*, issued quarterly, gives in one index the current medical and biological literature. We are grateful for these publications, whether we express it or not. They lighten very much the burden of reference hunting.

The following journals have been used in the study recorded here:

American Journal of the Diseases of Children
American Journal of Medical Sciences
American Journal of Physiology
Archives of Internal Medicine
Journal of Agricultural Research
Journal of the American Chemical Society
Journal of Bacteriology

Journal of Biological Chemistry
Journal of Cancer Research
Journal of Experimental Medicine
Journal of Immunology
Journal of Infectious Diseases
Journal of Medical Research
Journal of Pharmacology

TABLE III

Relation of the Biological Articles to the Total Number of Articles Published, 1907–1916

Periodical	Pages	Articles		
		Total	Bio-logical	Per Cent.
Am. J. Dis. Children	5,844	399	119	30
Am. J. Med. Sci.	—	1,351	168	12
Am. J. Phys.	12,135	864	500	58
Arch. Int. Med.	—	1,112	349	31
J. Agr. Res.	4,851	329	75	23
J. Am. Chem. Soc.	—	2,164	383	17
J. (Org. and Biol.)	—	994	383	40
J. Bact.	477	37	15	40
J. Cancer Res.	460	24	5	20
J. Biol. Chem.	14,384	1,304	1,304	100
J. Exp. Med.	11,648	885	398	45
J. Immunology	556	34	21	61
J. Infect. Dis.	—	692	289	42
J. Med. Res.	—	589	176	30
J. Pharm.	5,040	304	254	80

These were selected as most likely to contain the more important literature of biological-chemical interest. They do not contain all, by any means, as it is met with in the most unexpected places. It would be of interest to compile a complete list of all the work of biological chemistry published by the various American laboratories in all the periodicals, American and foreign. This the writer must leave to some one else.

Table III. contains a list of the total number of articles and the number of those of biological-chemical nature, and in some cases, the number of pages. As Sparks and Noyes pointed out, and as many others have remarked in discussing the subject, the number of pages has no real significance in many instances. Many short articles are of more value, scientifically, than other articles with their hundreds of pages. The length of an article depends too much upon the nature of the subject and the personality of the writer, and not enough upon its scientific value.

Table IV. contains a comparison of the number of articles (and pages in some instances) in those periodicals published during the periods 1907–1908 and 1915–1916. In those cases where the periodical was not published in 1907, the figures for the later period are given for comparison.

These tables bring out, rather forcibly, first, the large amount of biological work which is being carried out in this country, and second, the marked increase in this kind of research during the past decade. The curve will drop

TABLE IV

Showing Per Cent. Increase During the Ten-Year Period

Periodical	Pages			Articles Total			Articles Biological		
	1907–1908	1915–1916	% Increase	1907–1908	1915–1916	% Increase	1907–1908	1915–1916	% Increase
Am. J. Dis. Children	—	1,610	—	—	113	—	—	39	—
Am. J. Med. Sci.	—	—	—	257	275	7	18	49	17
Am. J. Physiol.	2,522	3,198	23	199	237	20	134	137	2
Arch. Int. Med.	2,468*	4,071	65	149*	252	69	38*	142	274
J. Agr. Res.	—	3,596	—	—	218	—	—	61	—
J. Am. Chem. Soc.	—	—	—	402	584	45	86	88	0.2
J. Bact.	—	477	—	—	37	—	—	15	—
J. Biol. Chem.	1,556	5,384	246	121	435	259	121	435	259
J. Cancer Res.	—	460	—	—	24	—	—	5	—
J. Exp. Med.	1,421	3,052	114	95	223	134	55	93	70
J. Immunology	—	556	—	—	34	—	—	21	—
J. Infect. Dis.	1,290	2,560	99	91	213	134	44	86	95
J. Med. Res.	2,881	2,062	—	125	128	2.5	35	55	57
J. Pharm.	—	1,715	—	—	117	—	—	103	—

* For the period 1908–1909.

somewhat during the period of the duration of the war, because of the large numbers of biological chemists and physicians who have already entered, and who will enter the government service. However, we may look for a return to the highest point of the curve as soon as normal conditions exist again. It would seem that one of the lessons we must learn from this terrible conflict is the national value of scientific research.

TABLE V

Institutions which Have Published Ten or More Papers in Any One Periodical

	Am. J. Physiol.	J. Biol. Chem.	J. Exp. Med.	J. Pharm.
Armour and Co.		10		
California	13	89	12	
Carnegie Nutrition	17	10		1
Exptl. Evolution	7	5		
Chicago	70	40	13	11
Columbia	21	23	30	6
Conn. Agr. Expt. Station	30	26		
Cornell Medical	25	46	3	7
Harvard	38	95	10	9
Health Dept., N. Y. City		3	10	
Herter Lab.		77		
Illinois	12	20	10	
Johns Hopkins	34	39	37	51
Mass. Gen. Hospital	1	16	1	7
Michigan	2	3	2	10
Missouri	4	14	2	3
N. Y. Agr. Expt. Station		35		
N. Y. Post Graduate		14		
Montefiore Home	2	13	1	
Northwestern	10	3		13
Pennsylvania	8	53	20	10
Rockefeller	16	135	114	8
Roosevelt		13		
U. S. Fisheries	5	19		
U. S. Hygienic Lab.		7		10
Vanderbilt	2		12	
Washington Univ.	6	18		6
Western Reserve	24	15	15	37
Wisconsin	14	57	7	9
Yale	35	117	11	8

Table V. contains a list of those institutions which have published ten or more papers (biological) in any one of the four periodicals tabulated, with the number of papers published in the others. (Lack of time prevented a complete classification of all the periodicals). Table VI. classifies the articles in these four periodicals according to the scheme used in *Chemical Abstracts*.

These tables and figures, incomplete as they are, give us an idea of the large amount of biological material which is being published yearly. As Professor Vaughan remarks about medical literature, some is good, some is bad, and much of it is indifferent.[4] While the direct responsibility for the quality of the work published depends upon the investigator himself, some of this responsibility must be laid upon the teachers of biochemistry of this country. This responsibility may even be carried back still farther, as Dr. Hammett[5] has recently pointed out, and may in part be placed on the shoulders of the teachers of the fundamentals of chemistry. It is a hopeful sign, in view of this responsibility, to see so large a number of the leaders of biological chemistry gathered in this conference for the improvement of its teaching. May the inspiration which is gathered here send us back to our desks and our laboratories with the determination to do our best the coming year to build deep and strong the foundations upon which the future biological publications will be based.

TABLE VI

Classification of Articles

	Am. J. Physiol.	J. Biol. Chem.	J. Exp. Med.	J. Pharm.
Organic	34	213	2	4
General Biology	58	196	2	1
Methods	16	180	8	14
Botany	0	17	1	4
Bacteriology	257	121	61	2
Physiology	29	171	69	62
Metabolism	63	265	24	2
Pharmacology	40	6	33	144
Pathology	21	38	166	17
Zoology	3	10	2	3

CLARENCE J. WEST

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE AGE AND AREA HYPOTHESIS

PROFESSORS SINNOTT AND BERRY[1] express themselves unfavorably to my hypothesis of "age and area," which Professor de Vries

[4] Editorial, *J. Lab. and Clin. Med.*, 1915–16, 1, 59.

[5] Hammett, F. S., SCIENCE, 1917, 46, 504 (Nov. 23); *Medical Record*, 1916, 90, 503 (Sept. 16).

[1] SCIENCE, N. S., Vol. 46, p. 457, November 9, 1917; p. 539, November 30, 1917.

has done me the honor to endorse in two reviews[2] in the same journal. But I may perhaps be permitted to point out that, though they object to the hypothesis, they put nothing in its place, and make no effort to explain the figures upon which it is based, and which are so clear and so consistent that if age and area be abandoned, or a rival hypothesis be set up, they can not be left without an explanation. The hypothesis was originally based upon the results obtained from the flora of Ceylon, where distribution was only estimated, and though there were many irregularities, the figures came out clearly enough for it to be fairly safe to publish the hypothesis. Since then, actual measurements of area occupied have been used—for New Zealand, the islands round New Zealand, Jamaica, Hawaii and Australia—and have given results which are far more clear and decisive, following in the most extraordinary manner what is required under the hypothesis. Its applicability has also been extended from the angiosperms to the Coniferæ and ferns.

Professors Sinnott and Berry, it seems to me, have to some extent misapprehended my views. They certainly give them too wide an application, and do not take sufficient notice of the provisos with which I have hedged round the use of age and area. For example, as I have several times pointed out, age and area must not be applied to single species (as Professor Sinnott applies it), but only to groups of 20 allied forms. In other words, it is primarily a proposition in taxonomic plant geography; and though I think that its application may probably be extended, I have as yet only applied it to groups of allied species within a single country, and to genera (the closest of groups) beyond.

I believe that *in general*, when there is a genus covering the range of its family, that genus is the parent of the rest of the family. But of course not infrequently there are two or more genera covering the family range, or two or more dividing it between them (*e. g.*, one Old World, one New). In the solution of this problem, with which goes the parallel fact that, as Professor Sinnott points out, genera are often represented in a given country only by endemic species, and the similar fact that species may be only represented by endemic varieties, there lies, I believe, a very large step on the way to modern theory of evolution.

There is no doubt that many species have in past times died out, or been killed out, but that is no proof that the process is going on now, though *man* is no doubt responsible for a great deal. Age and area, however, refers to action under practically unchanged conditions, and the advent of man may completely alter them.

Professor Sinnott so far extends the applicability of age and area as to make it responsible for the deduction that herbs are older than trees. In the first place these are *ecological*, not taxonomic groups, and the fact that they are undoubtedly very polyphyletic complicates the matter; and in the second place I have not said that the rate at which a herb and a tree spread is the same, though both are governed by age and area, and one covering 1,000 square miles bears the same age relationship to one that covers 500, in each case.

The attacks by Professors Sinnott and Berry are upon my first three papers on age and area.[3] Since then I have published[4] three more. The first is controversial, dealing with the inapplicability of natural selection, and with the question of relative age (in one country) of endemic and widely distributed species. I have shown by two crucial cases that the former are the younger. In New Zealand the widely distributed species take no notice of Cook's Strait (between the chief islands), while many endemics are held up there, having evidently arrived too late to get across before the formation of the strait. Again, in the Tristichaceæ and Podostemaceæ, the primitive genera, which resemble ordinary water plants, are spread throughout the tropics, while the extraordinarily dorsiventral forms, which

[2] SCIENCE, N. S., Vol. 43, 1916, p. 785; 45, 1917, p. 641.

[3] *Phil. Trans.*, 1915; *Ann. Bot.*, 1916.

[4] *Ann. Bot.*, 1917.

must be younger, are all local, and are no more numerous. I have shown in another paper[5] that one can not speak of adaptation in these plants, other than the first adaptation which enabled the families to live in running water.

Neither of my critics makes any attempt to explain why under my hypothesis one can make numerous predictions about the composition and distribution of a given flora—predictions which as yet have always proved to be correct on verification of the facts. For example, in the paper on New Zealand, to which they object, I predicted that the number of endemics found in each zone of 100 miles from north to south in New Zealand would show a maximum at some point (sometimes two) and a regular tapering away from this. This proved to be the case for every one of the 91 families and 392 genera—a result hitherto quite unsuspected, and which alone was almost enough to establish age and area in a higher rank than that of a mere hypothesis. In the second of my recent papers mentioned above I predicted that the species which reach the islands outlying round New Zealand (Kermadecs, Chathams, Aucklands) would on the whole be the oldest in New Zealand, and therefore very widespread there. This proved to be the case, not only generally, but in detail, the most widespread being those reaching all three groups of islands, the next those reaching two, then those reaching one, and finally those that were confined to New Zealand, however far they might range in the world in general. In this paper I have likewise shown that the area covered in New Zealand by the species that also reach Australia, etc., goes, not with the area covered in the world in general, but with that covered in the archipelago of which New Zealand is the principal part. This result seems to me to exclude any explanation based upon natural selection.

In the same paper it was predicted that the species endemic to New Zealand and the islands round it would also be very widespread in New Zealand. This proved to be the case; they are even more widespread than the average of the species which range beyond New Zealand to Australia and the rest of the world. This also is a fact that is quite inexplicable by natural selection.

It seems to me that a hypothesis that shows itself thus capable of being used as a basis for successful prediction deserves at least a very careful investigation before being rejected. One of the best proofs of its general applicability is the fact that other workers are beginning to apply it to the solution of various problems. Breakwell has already worked out the distribution of the grasses of Australia, and shown that it agrees with age and area. Small, in work now being published on the Compositæ,[6] has found it to confirm the evidence of other lines of work in phylogeny, and a third worker is applying it to the Leguminosæ.

In the last of the three papers mentioned above I have shown that the orchids of Jamaica are least widespread in that island when endemic to it, more widespread when also found in Cuba, and most widespread of all when ranging yet further than Cuba. It is also shown that the flora of the Hawaiian Islands fits the age and area hypothesis, as does the distribution of *Callitris* (Coniferæ) in Australia. The ferns of New Zealand and Hawaii are then considered, and shown to obey the same law, while confirming previous work on the greater youth of endemic species.

Finally, in two further papers, as yet unpublished, I have applied age and area in more detail. In my first (a reply to the criticisms of Professor Sinnott, who objects that age and area will not explain the flora of New Zealand) I have shown that New Zealand was peopled with plants in all probability by two chief invasions, one northern from Indomalaya, one southern. In the second paper I have dealt with the flora of Stewart Island (the southernmost of New Zealand) and have successfully made no fewer than 15 predictions about its composition and geographical relations, bringing out a number of points hitherto unsuspected or unnoticed.

JOHN C. WILLIS
CLARENDON ROAD,
CAMBRIDGE, ENGLAND

[5] *Proc. Roy. Soc.*, 1914.

[6] See his review in *Science Progress*, January, 1918.

THE RELATIVE AGE OF ENDEMIC SPECIES

In my previous reviews of the studies of J. C. Willis on endemic species I have explained his thesis that they are, as a rule, the youngest components of a flora and that their special condition is due to the circumstance that they have not yet had time to spread. This conclusion was based chiefly on statistical studies of the angiospermous floras of Ceylon and New Zealand.

It was to be expected that this contention would not escape contradiction, since among the older botanists the opinion prevails that endemic species are everywhere the relics of an old flora which is now rapidly disappearing. There is no doubt that in some countries this may be the case, and that even in the islands studied by Willis some few species are in this condition. But the number of these relics is so small that whenever a flora is studied statistically, they have no visible effect on the figures, provided that the species are dealt with in groups of about twenty or more.

The arguments against the hypothesis of the relative youth of endemics have been collected and brought forward in a recent article by H. N. Ridley and replied to by Willis.[1] In the first place it is claimed that it is difficult to show from which other species of the same flora the endemics should have been evolved. But Willis answers that most of them have "wides" of the same genus in their neighborhood, the "wides" being those species which also occur in adjoining countries, and are usually widely spread. A study of the diagnostical differences of the endemics with these goes to prove that in most cases they can easily be derived from them. Moreover it shows that these characters are by no means of an adaptive nature since they do not betray any relation to the life conditions of the local environment.

Ridley is an adherent of the Darwinian principle that organisms produce varieties, which if more suitable to the surrounding condition than the parent form are selected. This thesis, of course, is the basis of all evolutionary theories. But the question whether the production goes by infinitesimal steps or by larger changes, makes the difference between the theory of natural selection and that of mutation. On this point his criticisms clearly show that the more narrowly one looks into the actual facts the larger becomes the evidence against the older view. The reader will find a valuable review of the arguments in the papers of both antagonists, but it would take me too far to consider them here.

The main point of Willis's position, however, has been left unattacked. It is the statistical result that the endemics and the widely distributed species in a country are arranged in graduated series, showing an increase in number in opposite directions, the endemics increasing from those of wide to those of narrower distribution, the wides in the other direction. Or, in other words, the endemics of a flora are the more numerous the smaller their area is, whereas among the species occurring also outside the special flora studied, those with a wide distribution within it, prevail. The regularity with which these facts appear from the tables made for different islands and different botanical groups can not be explained on the old view. Neither is this possible for the fact that endemics have mostly contiguous areas, whereas the dying out of species should lead us to expect the occurrence of their last relics on sundry spots and on distant points of their original habitat.

This law of distribution, which Willis calls his law of "age and area" is then tested for some other floras, besides those already mentioned.[2] The orchids of Jamaica give a very convincing instance. Dividing the island into 19 equal squares and comparing the endemic orchids with those found also in Cuba, and

[1] H. N. Ridley, "Endemism and the Mutation Theory," *Ann. Bot.*, Vol. XXX., 1916, p. 551, and J. C. Willis, "The Relative Age of Endemic Species and Other Controversial Points," in the same journal, Vol. XXXI., 1917, p. 189. See also some other articles of the same authors in that journal, and my reviews in Science, N. S., Vol. 43, No. 1118, pp. 785–787, June, 1916, and Vol. 45, No. 1173, pp. 641–642, June, 1917.

[2] J. C. Willis, "Further Evidence for Age and Area, its Applicability to the Ferns, etc.," *Ann. Bot.*, Vol. XXXI., 1917, p. 335.

with those of still wider distribution, the tables show that their range goes in the order: Endemics least, Jamaica-Cuba species next, wides greatest. Then the angiospermous flora of the Hawaii archipelago, which comprises seven islands, is tested, and it is found that the wides range much more than the endemics, of which more than one half is found on one island only. These latter must be the youngest, the remaining having originated before the splitting up of the region into separate isles.

A study of *Callitris* in Australia shows that the law holds good for Conifers also, and the fern floras of Hawaii and New Zealand give ample material to prove that the endemic species, although following the same rule, show a much greater range than the endemic angiosperms, a result to be expected on Willis's hypothesis, but contrary to what one would expect if endemics were dying out, since ferns are generally considered as a much older group than the flowering plants. A last argument is given by the outlying islands around New Zealand. Starting from his hypothesis Willis predicted that the most widespread plants in the two main islands would be those that reach the outlying isles also, and that those which do not reach them, are less widespread. The figures given in the tables bear out this fact in a striking way, both in the case of wides and endemics.

From these results it seems clear that all over the earth and in every systematical group of plants the rule prevails that the most widespread species are the oldest, whereas the others are the younger, the smaller their area is. This law would provide us with a new method of constructing pedigrees and of judging the relative age of diagnostic characters, and it seems evident that these points would be of paramount importance in the study of the real relationships and the common origin of species.

Hugo de Vries

Lunteren, Holland

SCIENTIFIC EVENTS

THE CHICAGO MEETING OF THE AMERICAN MEDICAL ASSOCIATION[1]

The sixty-ninth annual session of the American Medical Association, held in Chicago last week, was one of the most important the Association has ever held. This statement is made as the meetings, the exhibits, the addresses and the results of the past week pass in retrospect before us. The House of Delegates considered many topics of current war interest and passed a number of resolutions of important, timely character, conspicuous among them being those on animal experimentation, on universal military training, on welfare work among children, on the use of enemy manufactured pharmaceutic products, and on the work of Surgeon-General Gorgas.

The opening meeting of the Scientific Assembly, held in the Auditorium Theater, was greeted by an audience of over 4,500 persons, every seat and available space in the theater being occupied. Unfortunately, many who desired to attend were unable to find accommodations because of late arrival. The music for this session was provided by the Fort Riley Band, which was a conspicuous feature of the annual session, and aided in arousing military enthusiasm. At this meeting, as in all of the night meetings, the medical officers in uniform were seated on the stage, and added military tone and color to the picture. The scientific programs began on Wednesday and contained numerous papers of military interest, as well as those of a strictly scientific character.

An unusual feature of the session was the replacing of the president's reception by a medical war meeting held in Medinah Temple, the report of which appears elsewhere in this issue. The local committee on arrangements had done notable work in staging this meeting. Every seat in the immense auditorium was filled, over 6,000 persons being present. The speakers were the noted foreign guests, the surgeon-generals, the president of Leland Stanford University and Major Alexander Lambert, of the American National Red Cross. The enthusiasm of the audience can not be depicted by words, every speaker and patriotic enunciation being greeted with an ovation. With the introduction of each foreign guest the audience, led by a local choral organization and accompanied by the music

[1] From the *Journal* of the American Medical Association.

of an immense pipe organ and the Fort Riley Band, sang a national song.

On Thursday, practically all of the scientific sections combined in two meetings of the greatest importance to the Army, the profession and the public. These meetings were held in the Auditorium and Studebaker theaters, and concerned the reconstruction and rehabilitation of disabled soldiers and the physical examinations made under the selective service. When the meeting in the Auditorium Theater opened, some 4,000 persons listened attentively to the message brought to them by representatives of the Surgeon-General's Office, of the Red Cross and of foreign nations as to the program for the care of the disabled fighting men in order that they may be returned to a useful civilian life. In the meeting on the selective service, Lieutenant-Colonel J. S. Easby Smith and Major Hubert Work, of the Provost Marshal-General's Office, were able to confer with the state aides of the governors of the various states who had been ordered to Chicago for this meeting, and to inform the many physicians representing the 23,000 physicians who are engaged in the work of the local, district appeal, and advisory boards under the selective service law, concerning many points which had not up to this time been made clear to them.

The Thursday night session was again a public, patriotic meeting. The Auditorium was again filled to capacity, the music on this occasion being provided by a detachment of the Great Lakes Naval Training Station Band and by group singing of the audience.

The scientific and commercial exhibits were open throughout the session and were noteworthy for their practical and military features. The commercial exhibit included practically all of the recently developed foods, pharmaceuticals and mechanical devices resulting from necessities created by the advance of scientific knowledge and the military emergency.

Special arrangements were made for entertaining the medical women who attended the session in large numbers and also for the amusement of women guests. The entertainments included receptions, teas, a musical and a visit to the Great Lakes Naval Training Station to attend the dedication of the new Red Cross building. Arrangements had also been made for a visit to the central department Red Cross headquarters and to local merchandise and industrial plants.

To add to the entertainment of the visitors to this session, a medical motion picture show was conducted throughout the session, numerous reels of film lent by the Medical Department of the United States Army being continuously exhibited, including the famous film "Fit to Fight," prepared by the commission on training camp activities. Captain H. M. Strong, post surgeon at Rantoul, Ill., was permitted to visit the annual session in an aeroplane, and arrived promptly on time in Chicago, being greeted by the Fort Riley Band and by many convention visitors.

The meeting also served to inform many physicians who are about to enter the military service concerning the routine of application and appointment, equipment, assignment to duty, etc. Medical military headquarters were in continuous operation, in charge of medical officers on active duty. Over 600 physicians were given information, supplied with application blanks, and many of them sent directly to the local examiner for physical examination.

The attendance at this session was the largest since the Chicago session of 1908. The total, 5,553, is but a meager 800 less than that of the 1908 session, and when one takes into consideration the fact that about 20,000 physicians are in active military service, that the services of many physicians are continuously needed by civilian communities and industrial institutions, and that railroad rates are comparatively higher than they have ever before been in the history of our country, the attendance at this session may well be said to have been phenomenal. No meeting of the Association has so successfully reached the public as did this sixty-ninth annual session, and the public showed its interest in the session and in the work which the medical profession is trying to accomplish, by attending in large

numbers every meeting in which arrangements had been made for it. The local committee on arrangements and the medical profession of Chicago are to be congratulated on the results of this session, and the thanks and appreciation of every Fellow of the American Medical Association is due them.

THE PRODUCTION OF OPTICAL GLASS IN THE UNITED STATES

The War Industries Board authorizes the statement that before the war little effort was made to produce optical glass in the United States. Manufacturers of optical instruments were able to obtain optical glass in desired quantity and quality from Europe and consequently did not feel the necessity for making it themselves. In 1912, however, the Bausch & Lomb Optical Co., of Rochester, N. Y., built an experimental optical-glass plant and placed a practical glassmaker in charge; by 1914 this company was able to produce a few types of optical glass which was used in optical instruments.

By the end of 1914 the importation of optical glass had become difficult and uncertain. Other firms, as Keuffel & Esser, of Hoboken, N. J., and Spencer Lens Co., Buffalo, N. Y., and the Bureau of Standards of the Department of Commerce, at Washington, began to experiment in making optical glass. By 1917, when the United States entered the war, the optical glass situation had become critical. The European supply was practically cut off. Optical glass had to be made in this country if our army and navy were to receive the fire-control instruments which they needed.

The Geophysical Laboratory of the Carnegie Institution of Washington was called upon to aid in the production of high-grade optical glass. A party from the laboratory was stationed at the plant of the Bausch & Lomb Optical Co. in April, 1917, and for seven months all efforts of the laboratory were concentrated at this plant. At the end of 1917 the essential details of the manufacture had been developed and glass in considerable quantities was being produced. The efforts of the laboratory were then extended to the Spencer Lens Co. and to the Pittsburgh Plate Glass Co., Pittsburgh, Pa. During this period the Bureau of Standards rendered effective aid.

At the present time, as a result of cooperation between the manufacturers and scientists, large quantities of optical glass of the kinds needed for military fire-control instruments are being produced of a quality equal in practically every respect to the best European glass. The need for a continuous and assured supply of optical glass is so great that the workmen trained in the details of manufacture and subject to draft, are being withheld from the draft in order that their technical training may be utilized at this time. The required information and details of manufacture and the skill necessary for proper production have been gained at great expense and under high pressure.

THE SOURCE OF TRENCH FEVER[1]

A cablegram from the commanding general of the American Expeditionary Forces to the Secretary of War reports the success of a trench-fever investigation, which was made possible through the willingness of sixty-six American soldiers to risk their lives. The message contains the names and home addresses of the men who submitted to inoculation. All of them now are either cured or convalescent.

These men were from field hospitals and ambulance organizations, units commonly designated as noncombatant. They were selected from a large group of volunteers as the healthiest and consequently the best able to withstand a long siege of trench fever, which has been one of the most baffling diseases which the allied armies have encountered. The men selected were sent to a hospital behind the British front line in January.

Trench fever is a disease which has been common on the western front. It may have existed before, but has not been either frequent or severe enough to direct the attention of the medical profession. Now it represents one of the greatest causes of disability in the allied armies. Nothing definite was known about either the cause or mode of spread of this disease.

[1] Publication authorized by the Secretary of War.

While it is probably never fatal by its nature, through frequent relapses and debilitating effects it may render a certain proportion of men permanently unfit for military service, and the approximate average time lost from this disease is six months. Therefore, in spite of the fact that it is not a fatal disease, from the military point of view it has been a serious one.

The problem of protecting our men, if possible, from this added suffering, was one of the first questions faced by the American Expeditionary Forces. Before any intelligent protective measure could be taken there were two points to be established. First, was this disease caused by germs? Second, if it was a germ disease how was it spread?

Attempts were made to use animals to establish these points, but no animals susceptible to this disease could be found. Therefore, as was the case of Walter Reed and his work on yellow fever, it was necessary to resort to volunteers from our army, who would be willing to sacrifice themselves that the many might be saved.

The first question studied was whether this was a germ disease. No germs could be seen with the microscope, but the Medical Department knew that there are numerous germs which can not be seen by even the most powerful magnification. Therefore this point had to be established by taking blood from men with the fever and injecting it into healthy men. Out of 34 such individuals inoculated with blood or some constituent thereof, taken from 7 cases of trench fever, 23 volunteers developed the disease. Out of 16 healthy men inoculated with whole blood from a trench-fever case 15 developed the disease. These experiments prove that trench fever is a germ disease and that the germs live in the blood of men so infected.

The next question was "How is this disease spread?" Naturally the body louse was to be considered first. Large numbers of these were collected from patients with trench fever and also some of the same kind were brought from England, which had been collected from healthy men. The lice from trench-fever cases were allowed to bite 22 men. Twelve of these later developed the disease, while four men bitten by lice from healthy men remained free from the disease. Eight other volunteers living under exactly the same conditions, in the same wards, but kept free from lice, did not develop trench fever. After blood inoculation the disease developed in from 5 to 20 days. After being bitten by infected lice the fever required from 15 to 35 days to develop.

With these facts in hand, namely, that trench fever is a germ disease and that it is carried by lice, it is now possible to take up the question of controlling, in an intelligent manner, the disease. As long as the protection of the men from lice was only a matter of comfort and of no military importance, their extermination did not warrant extraordinary measures, but now that it is known that it is not simply a matter of discomfort, but that the "cootie" (trench vermin) is incidentally one of the largest causes of disability, it is deemed worthy of extraordinary efforts to control these pests. It is a repetition of the question of mosquito control, yellow fever having been eliminated on the Panama Canal by these means.

It is no mean thing that these volunteers did in France. To face illness of weeks, with extreme suffering, requires peculiar valor. The average loss of weight for these men was from 20 to 25 pounds. Incidentally the hospital in which the experiments were carried out was shelled by the Germans in the early part of their March drive. It is believed by the Army Medical Corps that the sacrifice of this group of 66 men will in time lead to the protection of thousands of men from the ravages of trench fever.

SCIENTIFIC NOTES AND NEWS

AT the commencement exercises of Yale University the degree of doctor of science was conferred on Edward Sylvester Morse, director of the Peabody Museum, and on Dr. Henry Drysdale Dakin, the physiological chemist.

THE honorary degree of A.M. has been conferred by Harvard University on Outram Bangs, curator of mammals, Museum of Com-

parative Zoology at Harvard, and on Hennen Jennings, consulting engineer.

MAJOR RALPH D. MERSHON, formerly assistant professor of Ohio State University and now of the Naval Construction Board, has received the degree of D.Sc. from Tufts College.

WILLIAMS COLLEGE has conferred the degree of D.Sc. on Dr. Raymond Dodge, professor of psychology in Wesleyan University.

BOWDOIN COLLEGE has conferred the degree of doctor of science on Charles Clifford Hutchins, professor of physics at Bowdoin; on Donald B. Macmillan, the explorer, and on Colonel Winford H. Smith, the surgeon.

THE Willard Gibbs Medal for 1918 was conferred on William M. Burton, Ph.D., in recognition of his distinguished work in petroleum chemistry, at the meeting of the Chicago Section of the American Chemical Society on May 17, 1918. Introductory remarks by L. M. Tolman, chairman of the section, were followed by the presentation of the medal by Dr. Ira Remsen. A reception and dinner preceded the meeting at which informal addresses were made by Lucius Peter, president of the Chicago Association of Commerce; Thomas F. Holgate, president of Northwestern University; George N. Carman, president of Lewis Institute; W. E. Stone, president of Purdue University, and Julius Stieglitz, director of the department of chemistry, University of Chicago.

DR. ALLEN ROGERS has been appointed a major in the chemical service section of the National Army. He will be in charge of the Industrial Relations Department.

DR. E. B. FORBES, head of the department of nutrition of the Ohio Experiment Station, has been commissioned a major in the Food Division, Sanitary Corps.

DR. A. E. KENNELLY, acting head of the department of electrical engineering at the Massachusetts Institute of Technology in place of Professor D. C. Jackson, who went into government service a month ago, has been called to Washington for special work with the Signal Corps. He will be away from the institute during the summer months, but expects to return in the fall.

THE Pereira medal of the Pharmaceutical Society of Great Britain has been awarded to Miss H. C. M. Winch.

DR. NORMAN WALKER has been appointed inspector of anatomy for Scotland in the room of the late Sir James A. Russell.

G. MONTAGUE BUTLER, E.M. (Colorado School of Mines), has been appointed director of the Arizona State Bureau of Mines to fill the vacancy created by the resignation of C. F. Willis. He will continue to serve as dean of the College of Mines and Engineering, which position he has held for three years. The new director of the bureau intends to lay greater emphasis upon geological investigations, and will collect the data required for the preparation of a reconnaissance geological map of Arizona.

PROFESSOR ARTHUR HARMOUNT GRAVES, formerly of Yale University, has been appointed by the Office of Forest Pathology, Bureau of Plant Industry, for work during the summer months on problems relating to disease resistance in the chestnut tree.

PROFESSOR FRANK T. MCFARLAND, of the department of botany of the University of Kentucky, has charge for the summer of the white pine blister rust eradication in the states of Kentucky, Tennessee and Missouri, with headquarters at Lexington, Ky.

DR. S. K. LOY has resigned his position as professor of chemistry at the University of Wyoming to become chief chemist for the Midwest Refining Company. His office will be at Casper, Wyoming.

MR. W. J. MCGEE, of the Bureau of Chemistry, U. S. Department of Agriculture, and formerly stationed at Savannah, Ga., has been transferred to San Juan, Porto Rico, where he is engaged in the inspection of food and drugs.

THE Croonian Lecture before the Royal Society was delivered by Major W. B. Cannon, professor of physiology, Harvard Medical School, on June 20, the subject being "The physiological basis of thirst."

JOHN HARPER LONG, professor of chemistry at the Northwestern University Medical School for thirty-seven years died at his home in Evanston, Ill., on June 14, aged sixty-two years. Dr. Long, distinguished for his work in physiological chemistry, was vice-president of the American Association for the Advancement of Science in 1901 and president of the American Chemical Society in 1903.

FRANK N. MEYER, of the Department of Agriculture, has died in China. Mr. Meyer had travelled as an agricultural explorer through China, Siberia and Turkestan for nearly ten years and had introduced here many species and varieties of plants. He discovered the home of the chestnut bark disease.

MAJOR EUGENE WILSON CALDWELL, of the Medical Reserve of the army, an X-ray expert who recently perfected a device for stereoscopic fluoroscopy, died last week as the result of an operation to remove a cancerous formation on one of his arms, caused by burns received some months ago in making X-ray experiments.

A CABLE from London to the daily papers states that the American Army, at the suggestion of the French, is adopting the metric system for all war purposes, *e. g.*, for artillery, machine-guns, maps, etc. The convenience of such an arrangement is obvious as all "parts" become thereby interchangeable.

UNIVERSITY AND EDUCATIONAL NEWS

GIFTS to Yale University in the past year and credited as endowment made a total of $1,279,764, the alumni were informed by President Arthur T. Hadley at the commencement luncheon. From time to time gifts have been announced, but the new items included $100,000 as the Earl Williams Fund from Mrs. James Harvey Williams for the benefit of the University Press, and $400,000 from William L. Harkness, '81, as a building fund. The Williams Fund is a memorial to Earl Williams, 1910, 301st Field Artillery, who died in May. For the present the income will be used in war relief. The Harkness building after the war will be placed on Dwight Hall site, and will contain lecture and classrooms.

UNDER a compromise agreement Columbia University will receive half the estate of the late Robert B. Van Cortlandt. The value of the estate is said to be about $1,000,000.

A GIFT of Liberty Bonds and checks totalling $100,000 to Harvard University from 206 members of the class of 1893 is announced.

EIGHTEEN fellowships and thirty-three scholarships have been established for students in chemistry at colleges and universities throughout the country by the du Pont Company. The total value of these awards will be $25,000, the fellowships carrying $750 and the scholarships $350 each for the coming scholastic year. The fellowships are distributed among seventeen colleges and universities and the scholarships go to thirty-one institutions of learning scattered through the country, every section from the Atlantic to the Pacific, and from the Canadian border to Texas being included. The fellowships are for postgraduate work and will be established in the institutions which have the most advanced courses in chemistry. The scholarships go to members of the senior classes in institutions which pay particular attention to chemical instruction. The recipients of these awards, which are to be known as "du Pont fellowships" and "du Pont scholarships," are to be selected by the institutions themselves, the only condition made by the du Pont Company being that they shall go to students who have devoted the major part of their time to chemistry.

THE *Journal* of the American Medical Association states that a donation of $2,000,000 has been promised to the University of Toronto for research work. Professor A. B. Macallum, chairman of the scientific and industrial research council of Canada, urges that research science faculties should at once be established at McGill and Toronto universities.

DR. LAUDER W. JONES, head of the department of chemistry in the University of Cincinnati, has resigned to become head of the department of chemistry in the University of

Minnesota. He has been granted a leave of absence for a year in order to take charge of the Research Division of the Gas Offensive at the American University in Washington. Dr. Harry S. Fry, associate professor, has been appointed acting head of the department of chemistry in the University of Cincinnati.

John F. Guberlet, A.M. ('11, Illinois), Ph.D., '14 (zoology), who since 1915 has been professor of biology at Carroll College, Waukesha, Wisconsin, has recently accepted the position of assistant parasitologist at the Oklahoma Agricultural and Mechanical College and Experiment Station, at Stillwater, Oklahoma. He will take up his work in Oklahoma on July first.

Herbert Ruckes, in charge of the department of biology at Grove City College, has resigned to accept a position in the department of biology at the Agricultural and Mechanical College of Texas. For the past year Mr. Ruckes has been carrying on a botanical survey of Mercer county, Pa.

Professor H. V. Tartar, who for the first five years has been station chemist and associate professor of agricultural chemistry at the Oregon Agricultural College, has accepted a position in the department of chemistry of the University of Washington at Seattle.

DISCUSSION AND CORRESPONDENCE

SOLUTION TENSION AND INDUCTIVITY

To the Editor of Science: In Science of May 3, Professor Fernando Sanford, of Stanford University, describes a concentration cell in which the direction of deposition is the reverse of what would be expected if it were previously assumed that the solution tension of the metal is constant for both solvents. He offers an explanation connecting the phenomenon with the dielectric property of the solvent.

In the absence of quantitative data, the great difference known to exist between the solution tensions of a metal in different solvents would seem a sufficient explanation. It is true that in the Nernst theory of the concentration cell prior to 1894 it was supposed that the solution tension of a metal was a constant property of the metal at a given temperature; but the supposition was short lived, as it involved a difficulty exactly like the one in question, and led to measurements of solution tension in water and in alcohol,[1] so that apparently a difficulty has been raised which does not exist.

It may well be, as Professor Sanford suggests, that there is a relation between solution tension and the inductivity of the solvent, just as there must be a relation between inductivity and dissociating power, since the forces between charged bodies vary inversely as was remarked by J. J. Thomson and by Nernst. The same consideration would indicate a relation between the effective solution pressure of a metal and inductivity, since there could hardly be a more typical condenser than the Helmholtz "double layer." Certainly the quantitative investigation of the matter is greatly to be desired.

An assumption of constancy of solution tension of a metal in contact with varying concentrations of its ions in the *same solvent* is not warranted; although the results of computations using the equation for electromotive force,

$$\pi = \frac{RT}{nF}\left(ln\,\frac{P_1\cdot p_2}{P_2\cdot p_1}\right),$$

in which the solution tensions, P_1 and P_2, are assumed to cancel, and the ionic concentrations, $m_1\alpha_1$ and $m_2\alpha_2$, are substituted for the osmotic pressures, p_1 and p_2, would indicate that the simplified equation is at least approximately true.

On *a priori* grounds, the assumption is contradicted by the probability that the maintenance of ionization is largely due to an association of the charged particle with molecules of the already associated solvent, as well as that large inductivity and association certainly accompany each other, even if no simple relationship exists. So that it seems reasonable to expect, as he points out, that the inductivity of a solvent would change with changing concentration of ionic solute. But the change is in

[1] H. C. Jones, *Zeitschr. f. physik. Chem.*, 14, 346 (1894).

the opposite direction to that supposed in Professor Sanford's explanation, because increase in ion content must increase the inductivity of the solution, as will appear from the following consideration:

As ions pass from the metal into the solution, the changing composition of the mixture is accompanied by an increase in its density. The density, d, of a solution of any given concentration is related to its index of refraction of light, n, approximately as shown by the equation, $(n-1)/d = R$, the specific refractive power, a constant. A more concentrated solution, *i. e.*, a different proportion of the same components, which has a greater value for d, will also have a greater value for n, since the values of these physical properties depend additively upon the values of the same properties of the components. It would not be proper to substitute for n in the above expression the square root of the dielectric constant, as the electromagnetic theory might suggest, because the latter relationship is not capable of experimental test under the conditions for which the former is found to hold. But while the exact form of the function may be unknown, there can be no doubt that when refractive index increases as in the above case, the inductivity must increase also.

Applying this to a concentration cell, on the dilute side the inductivity of the solution is increasing, and this increment in the inductivity favors the further solution of the metal, but the osmotic pressure of the metallic ions is also increasing, and this increment opposes the further solution of the metal. Solution pressure, the predominating force on the dilute side, is aided by inductivity, and these together constitute a growing force—opposed, however, by a more rapidly growing force, osmotic pressure. In the more concentrated solution around the other electrode, we have an initially greater inductivity which is decreasing as metal ions are discharged and deposited, and this decrease of inductivity favors the deposition (or opposes the solution) of the metal; but the osmotic pressure of the metallic ions is decreasing also, and this decrease opposes the deposition. On this side, solution pressure is aided by a relatively large but decreasing inductivity, and combined they constitute a diminishing force which is initially weaker than the opposing osmotic pressure, but stronger than the corresponding solution pressure of the other electrode. All of the pressure differences in the cell owe their existence to the difference in concentrations of the solutions, and all reach equilibrium when the concentrations become equal.

In formulating the total combined effects on both sides of the cell the inductivity effect is either added to the solution pressure or subtracted from the osmotic pressure of the cations in solution. We are not so much concerned here with the value of the ratio we call inductivity or its nature, as with its effect, which is a pressure. Let us call this the modulus i, then the familiar equation becomes

$$\pi = \pi_1 - \pi_2 = \frac{RT}{nF}\left(ln\frac{P(1+i_1)}{p_1}\right) - \frac{RT}{nF}\left(ln\frac{P(1+i_2)}{p_2}\right) = \frac{RT}{nF}\left(ln\frac{p_2(1+i_1)}{p_1(1+i_2)}\right).$$

In this we have assumed, after all, that fundamentally the solution pressure is constant, but that there is a difference in *effective* solution pressure due to difference in inductivity. This seems reasonable where we are dealing with the same solvent as in a simple concentration cell: here the differences in inductivity are probably small. Would this equation suffice for different solvents in which i_1 and i_2 are unrelated, or must we still keep P_1 and P_2 distinct and find some further cause for a difference in solution tension of the same metal?

A series of inductivity measurements for varying concentrations of, say zinc sulphate. in water, with measurements of electromotive force of elements composed of zinc in the same concentrations of the salt, might lead to a clearer knowledge of the magnitude of solution tension, and might even throw some light on the as yet unknown forces whose resultant we call dissociating power.

In conclusion, allow me to say that this is not written in a spirit of controversy, but in order to place a little of our existing knowl-

edge at what may be a new angle to some one else who may thereby perceive a generalization or means to discover one. This, which seems to be the purpose of discussion, will be served as well even though I may have fallen into errors far more grievous than the apparent one that has occasioned this communication.

HORATIO HUGHES

THE TRUE SOIL SOLUTION

JUST recently, Dr. C. B. Lipman has published[1] a preliminary paper describing a "new method of extracting the soil solution," by subjecting the soil to a maximum direct pressure of 53,000 pounds to the square inch. This preliminary article describes briefly the apparatus used in obtaining this enormous pressure and claims for this new method the "obtaining of the soil solution *as it exists*[2] in relatively thin films around the soil particles. The procedure is rapid, clean and of high efficiency. With further improvements in apparatus which we now are planning, the method should supplant all other methods known to-day, including even the Morgan procedure." The fault found with the Morgan method is that it is "laborious and slow, and introduces the factor of oil which complicates and renders it extremely time-consuming and untidy."

Let us look at the important points Dr. Lipman claims for his direct-pressure method.

It allows of the direct determination of the concentration of the soil solution, and of the amounts of each of the solutes contained therein.

The physical chemist is familiar with the fact that pressure is a considerable factor in influencing solubilities and it does not seem logical that a method employing such enormous pressures could obtain the soil solution "as it exists" in the soil without upsetting the whole physico-chemical equilibrium of the real soil solution; its specific gravity, viscosity, surface tension, osmotic pressure, specific conductivity and its chemical composition would all suffer more or less of a change which would combine to render the solution worthless to the plant physiologist or to the plant physiological pathologist from a scientific point of view. The reason that the soil solutions obtained by other methods are at fault is largely because the water added in extracting the soil changes the solubilities of certain of the ingredients. The van Suchtelen-Itano paraffin-oil displacement-pressure method described by Morgan[3] was worked out carefully with just the opposite idea in mind, *i. e.*, to subject the soil to *as little pressure as possible* so as to preserve intact the physico-chemical equilibrium of the solution obtained. To this end the most inert oil was carefully selected as the displacement medium and pressures not exceeding 500 pounds per square inch were employed for forcing the oil into the soil. The preliminary tests[4] of the paraffin-oil displacement-pressure method, run by van Suchtelen and Itano before extensive work was done by these investigators and by Morgan, show that the inactive paraffin oil when brought into intimate contact with the soil solution did not change the electrical conductivity, chemical composition nor surface tension. The solution is literally pushed out of the soil by the inert oil, only sufficient pressure being used to force the viscous oil into the soil.

The oil-pressure method is somewhat time-consuming, laborious and untidy, but common workmen after being carefully instructed can do this work under the supervision of the trained scientists; again, not one but a battery of as many cylinders as desired can be used to obtain sufficient quantities of solution in a minimum time. However if Dr. Lipman's above contentions did hold true in every respect the end in view, *i. e.*, the obtaining of a solution representing *most nearly in all re-*

[1] Lipman, C. B., "A New Method of Extracting the Soil Solution," Univ. of Calif. Publ. in Agr. Sciences, Vol. 3, No. 7, pp. 131–134, March 15, 1918.

[2] Italics ours.

[3] Morgan, J. F., "The Soil Solution Obtained by the Oil Pressure Method," *Soil Science*, Vol. II., No. 6, 1917, pp. 531–545, Pl. 1.

[4] Report of the Bacteriologist, 26th Annual Report of the Michigan State Board of Agriculture, pp. 152–153.

spects that of the actual soil solution, should be the first consideration.

To the soil bacteriologist the solution obtained under great pressures would be of doubtful value. Many bacteria are destroyed by high pressures (25,000 to 100,000 pounds). In fact high pressures alone have been employed successfully in the sterilization of fruits and vegetables.[5] Studies of the microorganisms surviving these enormous pressures would be probably only a matter of curiosity and of no immediate value or utility.

It seems that Dr. Lipman should have made a thorough comparative study of the soil solution obtained from the same soils by the two methods under discussion before he could be justified in making the statements set forth in his preliminary article.

ZAE NORTHRUP
BACTERIOLOGICAL LABORATORY,
MICHIGAN AGRICULTURAL COLLEGE,
EAST LANSING, MICH.

DRAWINGS ON LANTERN SLIDES

PROFESSOR GUNTHORP'S letter in SCIENCE for April 12 in regard to drawings on lantern slides seemed to the writer to be an attempt to solve the problem of writing upon clear glass when the ordinary coated slides were not available. The letter by Mr. Benton in the issue for May 17 goes further into the solution of this problem, and the suggestion of using india ink is a good one, but the idea of pasting paper to a slide to secure a purchase for the foot of a compass would lead one to suspect that the use of coated glass had not been tried. Even though this supposition is in error the use of ordinary unexposed lantern slides, fixed in the dark room, or of old slides reduced by successive immersions in "hypo" and Farmer's solution, may be new to some and is worthy of mention. The transparency of the prepared slide is all but perfect, the coated side can be written, drawn or ruled upon at will, areas can be shaded or colored, errors can be removed by the simple expedient of scratching away the gelatin (and the remaining scar is surprisingly insignificant when the slide is thrown upon the screen) and dividers or compass can be used without danger of slipping. In writing, the finer and firmer the point, and the less ink, the better, as a thick line will crack up into a mosaic; and experience has shown that ordinary fountain pen ink is much less liable than india ink to crack in this way or to "ball" at the ends of the strokes. Waterproof inks must be used, however, if the slides are to be wet. If it is desired to render large areas opaque, and it is impracticable to use successive thin coatings, cover them with india ink, preferably using a brush, and when the surfaces have dried and cracked cover them again.

In coloring slides drawing inks may be used and the surfaces so colored will not crack if the ink is applied in thin enough coats. Higgins's carmine will be found less suitable than the other reds because of its heaviness of body and rapidity of drying. A simple method of improving one's chances of securing a smooth result, however, is to soak the drafted slide in water and then allow it to dry until there is no free moisture present, until it is sticky, before the colors are applied. If these precautions are taken and the wash is not too thick an even uncracked surface will result. Water colors, especially the stains and "lakes," are highly transparent and generally preferable to many of the drawing inks. For blended outlines the colors should be put on while the slides are covered with water in the customary way, but for the sharp outlines which will usually be desired in drafted slides the latter should be approximately or entirely dry.

Lantern slides prepared in this way need not be covered to preserve the writings or figures from abrasion, always a troublesome feature when clear glass is used. Fingermarks will show, though a slide pinched between the fingers will take a mark more readily upon the clear than upon the coated side, but these can be removed from the latter, almost irrespective of the ink or coloring materials used, by washing with pure alcohol. The ounce of pre-

[5] Hite, B. H., Giddings, N. J., and Weakley, Chas. E., Jr., "The Effect of Pressure on Certain Microorganisms Encountered in the Preservation of Fruits and Vegetables," West Virginia Station Bulletin 146, 1914.

vention is to paste a border of ordinary black binding tape on the coated side before work upon the slide is begun. This is an easy method also of inhibiting any tendency to write upon more of the slide than can be shown upon the ordinary screen.

LANCASTER D. BURLING
GEOLOGICAL SURVEY,
OTTAWA, CANADA

CELLOIDIN-PARAFFIN METHODS

THE review of Apáthy's[1] celloidin-paraffin method published in SCIENCE by S. I. Kornwork the present writer chanced upon, although actively interested between the years 1912–1915 in similar methods of imbedding plant tissues.

During research studies in plant anatomy, bulbs of *Cooperia Drummondii* were found to be particularly troublesome material to imbed. The delicate scales contain starch, calcium oxalate crystals and a mucilaginous slime which may coagulate during killing and fixation. These scales are attached to a base or axis formed of parenchyma, it is true, yet of parenchyma of an entirely different structure from that of the scales. The difficulties encountered because of the included materials plus the variance in structure of the bulb axis and its attached scales caused a wide search for a suitable imbedding medium. The choice at last was a combination of celloidin and paraffin, the advantageous qualities of which can not be emphasized too strongly. As Dr. Kornhauser points out, celloidin in contact with the object prevents shrinkage of the material on cooling and paraffin allows of serial sections which can be readily spread on the slide. Whether there are advantages or disadvantages in Apáthy's oil mixture I do not know, having never tried it, but I do know that entirely satisfactory results can be obtained with material which can be handled neither in paraffin, in celloidin, in agar-agar, nor in rubber and paraffin, by a much more simple celloidin-paraffin method than that of Apáthy's. The technique planned and followed out by the present writer was simply as follows: Material is treated to the celloidin process of imbedding up to the point where the object would usually be set in a block. Instead all surplus celloidin is removed from the object which with the adhering and infiltrated celloidin is hardened in 70 per cent. alcohol and later placed for clearing in chloroform for two hours. The next step is to place the object in 85 per cent. alcohol and from there on to follow the paraffin method. Material thus treated cut with an unusual smoothness, making it possible to obtain serial sections 10 μ in thickness with an ease that was a surprise and also a great comfort.

If one desires to cut serial sections of objects too large for the block of a rotary microtome or to be handled in paraffin, such large objects imbedded in celloidin (mature bulbs) can be cut into sections 50–75 μ thick with the sliding microtome, and placed immediately in 70 per cent. alcohol, from which they can be carried through the alcohols and imbedded in paraffin. It seems probable that Apáthy's oil mixture would be a valuable asset here because in cases where it is necessary to retain considerable celloidin, *e. g.*, in handling bulbs where the scales ordinarily fall apart on cutting, it would prevent the shrinkage caused by the drying effect of the alcohols and the heat from the bath.

There are surely two advantages to the celloidin-paraffin method as commonly used by the writer, (1) its simplicity and (2) the removal of surplus celloidin, a substance affected by the drying effect of the higher alcohols and heat and also inert itself in histological value and yet troublesome because of its affinity greater than that of plant tissues for stains such as gentian violet and safranin.

MARGARET B. CHURCH

[1] Apáthy, S., 1912, "Neuere Beitraege zur Schneidetechnick," *Zeitschr. wiss. Mikr.*, Bd. XXIX., S. 449–515, 4 textfiguren.

[2] Kornhauser, S. I., "Celloidin Paraffin Method," SCIENCE, N. S., Vol. XLIV., No. 1134, pp. 57–58, July 14, 1916.

ALLIGATORS AS FOOD

AN article by the writer on "Reptiles as Food," which appeared in the December, 1917, number of *The Scientific Monthly*, having

excited the curiosity of the members of a large boarding house in Morgantown, W. Va., it was suggested that a collection be taken among those interested to buy a couple of small alligators and have them cooked, to see if the flesh really was as agreeable as was claimed in the article in question. The writer agreed to buy the animals and prepare the flesh for cooking.

Sufficient funds were collected to buy, of the Arkansas Alligator Farm, two alligators, each about three feet in length. These were killed by cutting the cord at the base of the skull, and the flesh of the entire body was cut into pieces of suitable size for cooking.

The meat was first parboiled (though the necessity for this was doubtful) and was then fried in egg and cracker crumbs, very much after the manner of a breaded veal cutlet.

About thirty people, consisting of both men and women, mostly school teachers, members of the university faculty, and college students, partook of the repast, and all declared the meat to be "delicious."

There was considerable difference of opinion as to what the meat resembled: some thought it tasted like pork; some thought it like fish; one person said it suggested lobster; but all declared it to be most agreeable.

Of course, at the prices charged by supply firms the cost of live alligators would be prohibitive, but in the tropics, where crocodilia are often extremely abundant, the flesh could be had at a very low cost.

The writer has seen alligator hunters, in our Southern states, throw hundreds of pounds of alligator meat to the carrion crows and buzzards, after removing the hides.

Whether the Central and South American crocodiles would be as pleasant for food as the Florida alligator the writer can not say.

Albert M. Reese
West Virginia University

SCIENTIFIC BOOKS

Genetics in Relation to Agriculture. By E. B. Babcock and R. E. Clausen. New York, McGraw-Hill Book Co. 1918. Pp. xx + 675, 4 plates.

Professors Babcock and Clausen have given us a valuable new book on the subject of genetics. As the title suggests, the book is intended primarily as a text-book for students of agricultural genetics. It will, however, be of great value also to those whose interest in genetics is not primarily in its agricultural bearings. This is true partly because of the very fact that the authors have brought together a large amount of data from the agricultural publications that is not ordinarily familiar to the geneticist who is working along other lines.

The book is divided into three parts, entitled Fundamentals, Plant Breeding and Animal Breeding. All three contain much material that will be interesting to all students of the subject.

In part 1 the advanced student will find little that is new to him; but he will find a clear and well-written account of the important principles of genetics. The material drawn on for purposes of illustration is well selected, and is up to date—a very important point in a subject developing as rapidly as genetics. In the case of matters still under debate, such as multiple allelomorphism and selection, the authors have presented both sides of the question impartially, and have then weighed the evidence and drawn their own conclusions as to probable correctness. The chromosome hypothesis is adopted, and is used throughout the book in interpreting examples. The work on *Drosophila* is given a prominent place, and the results obtained with that fly bearing on the questions of linkage, crossing over, non-disjunction, mutation, multiple allelomorphs, etc., are carefully and simply presented. The question of pure lines and selection is discussed at some length, and the conclusion is reached that multiple factors offer the most plausible explanation of the phenomena.

The chapters on species hybridization and on the statistical study of variation should both be useful, as they present material that is not adequately discussed in other standard text-books on genetics in English. In the latter chapter the standard deviation and average product-moment are referred to as

absolute values, the coefficients of variability and of correlation as relative values. It seems to the reviewer that the latter, rather than the former, are absolute values; for they are the ones that are independent of the units of measurement used. The point is not one that is likely to cause confusion, as it is at all times clear what the authors mean.

In the chapter on species hybridization the "reaction system" idea is discussed at some length. According to this hypothesis, which has been developed by Goodspeed and Clausen on the basis of their species crosses with tobacco plants, the whole group of genetic materials of a species (the "reaction system" of that species) may behave as a single unit, or nearly so, in influencing dominance and viability in hybrids. The term "reaction system" seems to the reviewer to be rather unfortunate, as it is commonly applied to any system that is undergoing change, organic or otherwise. There can be no question of the very great interest of the facts that have been discovered by Goodspeed and Clausen, but in the opinion of the reviewer more detailed evidence is needed, especially as regards the cytological behavior of the F_1 hybrids, and the genetic behavior of the plants produced by back crossing the F_1 to both parent species, before the conception can be adopted as more than an interesting suggestion.

In parts 2 and 3 a large amount of data bearing on the genetics of domestic animals and plants has been brought together, and has been presented in a thoroughly scientific manner. This makes these sections useful also to the non-agricultural geneticist. To the practical breeder these sections should be invaluable, not alone because of the genetic data they contain, but also because of the discussions of methods of securing and recording information, and of the practical application of genetic knowledge. The chapter on beliefs of practical breeders is especially noteworthy; it gives in concise and convincing form the evidence against telegony, maternal impressions, and similar notions sometimes held by breeders.

The subject of eugenics is treated only very briefly and incidentally, and even then with a word of warning as to the reliability of the conclusions reached. No attempt is made to take advantage of the great popular interest in eugenics by exaggerating the importance and significance of the results that have been reported.

The authors are to be congratulated on a book that is well printed, well illustrated, well written, and that contains a surprisingly large amount of material that is conveniently arranged and adequately presented.

A. H. Sturtevant

SPECIAL ARTICLES

A NEW GRAPHICAL METHOD FOR COMPARING PERFORMANCE WITH PROGRAM OR EXPECTATION

The graphic method is generally recognized as a most important means to interpret facts to administrative executives as well as to the public. For the sake of simple comparison the well-known bar diagram (besides many other diagrams) is, of course, frequently used, but the latter, especially in the case of a variable delivery or production against time and a fixed quantity (requirements or expected production), loses its value. This characteristic rigidity of the bar diagram permits analysis of only one particular instant of the situation, with no reference to the past or future. For instance, if the total output of flour of a certain milling division starting from January 1, 1918, up to, let us say February 9, 1918, is expected to be 1,814,000 barrels, and up to

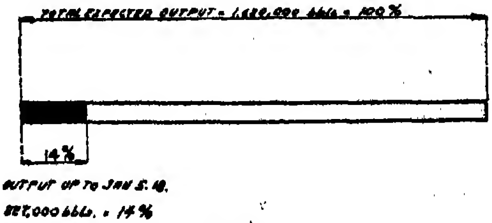


Fig. 1.

January 5, 227,000 barrels of flour have been manufactured, the situation expressed by a bar diagram (Fig. 1), using the expected output as a 100 per cent. basis, would be:

Total expected output = 1,620,000 barrels = 100 per cent.

Output up to January 5, 1918 = 227,000 barrels = 14 per cent.

We can see readily that no conclusions whatever could be drawn as to the output rate or as to the actual number of barrels of flour which should have been manufactured up to January 5, 1918, if the goal is to be reached on February 9, 1918. Besides that the bar diagram requires each time, when the output has been increased, a new calculation of the output in percentage of the total expected output.

To overcome this difficulty and especially to avoid the constant recalculation and redrawing of the bars a more efficient graphic method was devised. The new method with its new diagram automatically takes care of the whole period in which production is expected.

The expected output after having been carefully calculated is based on a uniform production rate throughout the given time. Graphically expressed the requirements or the expected output are a straight line, the tangent of which is the production rate or as shown in Fig. 2.

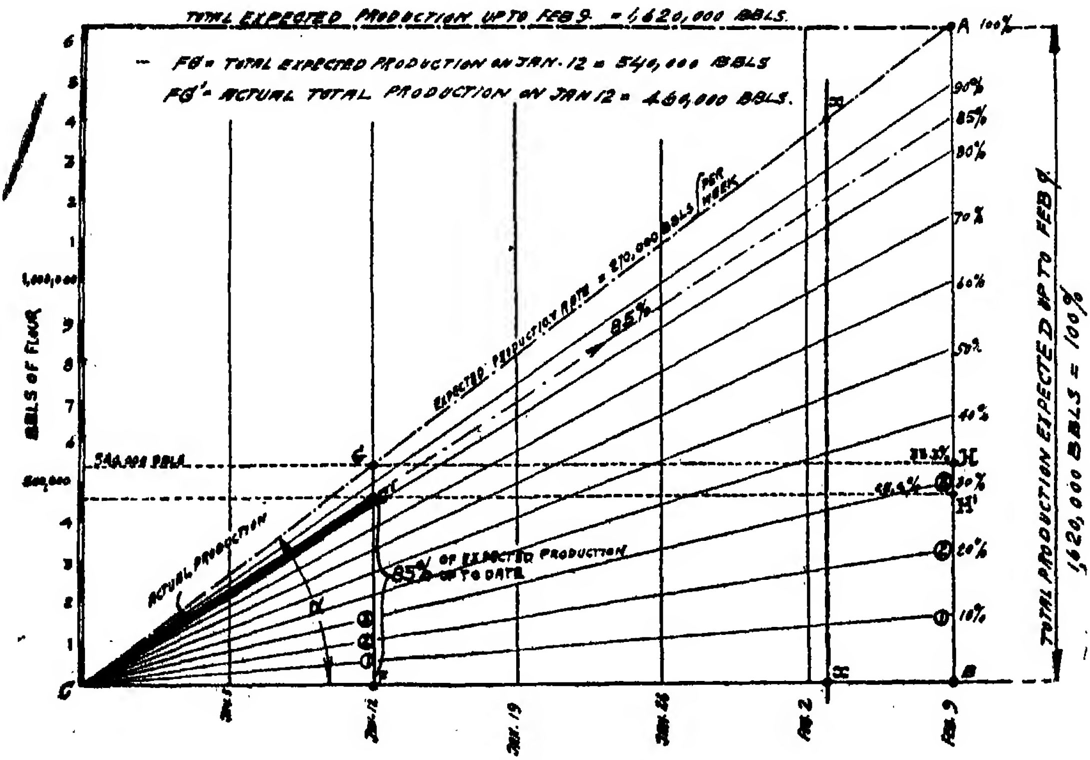


FIG. 2.

$$tg\alpha = \frac{\text{Total expected production}}{\text{Total time}} = \frac{AB}{CB}$$

$$= \frac{1,620,000}{6} = 270{,}000 \text{ bbls. per week.}$$

Based on this average uniform production rate the total required production at the end of the sixth week (February 9, 1918) would be

$$270{,}000 \times 6 = 1{,}620{,}000 \text{ barrels.}$$

For any time interval the total expected production can be easily deducted from the following proportion (Fig. 2):

$$CB : BA = CF : FG,$$

FG being x,

hence

$$x = \frac{BA \times CF}{CB} \text{ or in figures,}$$

$$x = \frac{1{,}620{,}000 \times 2}{6} = 540{,}000 \text{ barrels,}$$

which represents the required production of the milling division for a two-weeks period.

If now the line AB is divided into 10 equal parts, then $AB/10 = 10$ per cent.; $2 \times (AB/10) = 20$ per cent.; $3 \times (AB/10) = 30$ per cent., etc., of the total expected output. From the preceding it is clear that a line drawn through point G, parallel to BC, (Fig. 2) which intersects with the vertical line AB in H will express in its total magnitude BH the amount of barrels of flour manufactured *up to date* in per cent., of the total expected production (requirements) or:

$$\frac{540{,}000}{1{,}620{,}000} = 33.3 \text{ per cent.}$$

If furthermore FG is divided into ten equal parts and FG–1 is connected with AB–1, and FG–2 is connected with AB–2, it is easily seen that all vertical lines between C and B, for instance X—X, are also divided into 10 equal parts, and as the magnitude of all vertical lines represents production, we can express the actual production in two ways:

1. Production in *percentage of total production or output at the end* of the expiration date (in our case February 9, 1918),

or

2. Production in percentage of the total production up to *any period between* the start of production and the expiration date.

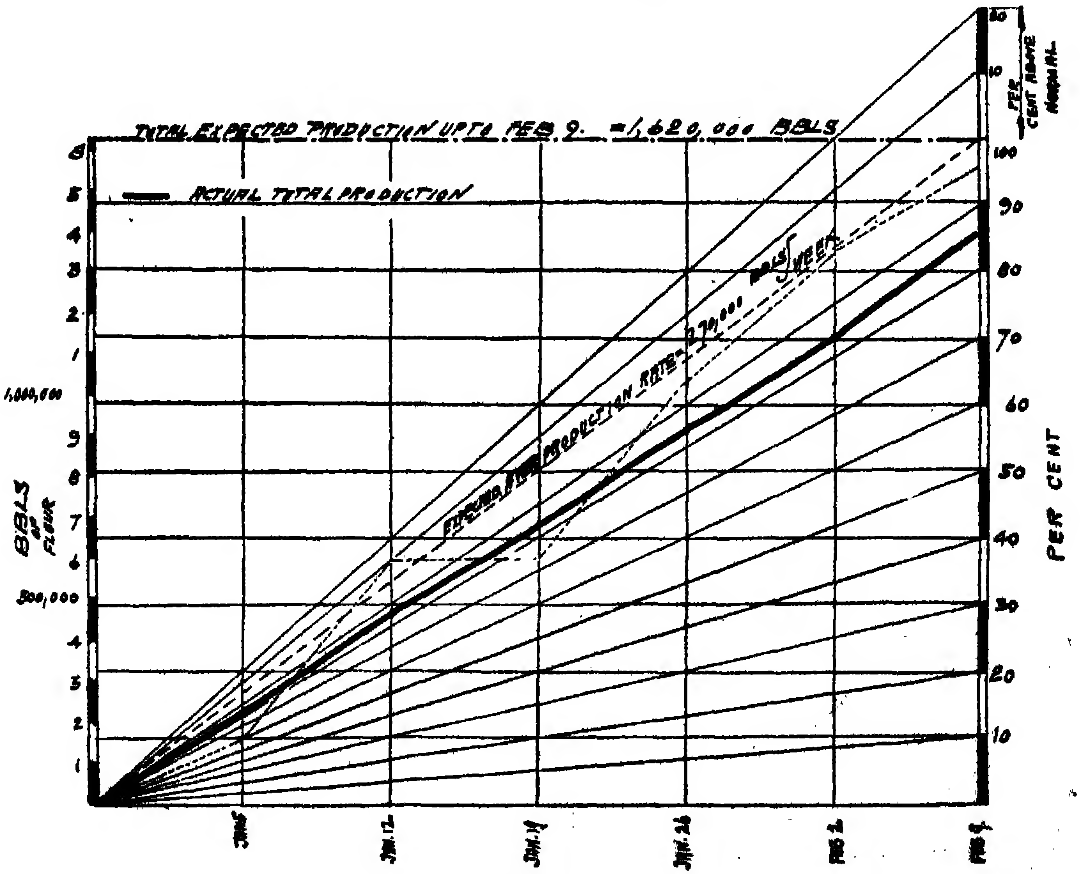


Fig. 3.

To illustrate that; if for instance the total production of a milling division up to January 12 should be 460,000 barrels instead of the expected 540,000 barrels production up to January 12, 1918, equals the magnitude of

$$FG^1 = \frac{460,000}{540,000} = 85 \text{ per cent. (Fig 2)},$$

which is the total actual production up to January 12 expressed in percentage of the total expected production up to *that date*. The other 15 per cent. are a *deficit* which can only be equalized through an *accelerated production rate* during the rest of the time which is available for production. Whereas:

$$\frac{460,000}{1,620,000} = 28.4 \text{ per cent.}$$

is the production of the milling division expressed in per cent. of *the total* production in barrels expected at the *expiration date* of the total time interval in question. Both instances are easily recognized in the diagram and read off on the right-hand scale. The left-hand scale in the diagram gives the *actual* number of barrels of flour *produced*. Through this graphical method all the different functions which are at work during the total production period are easily analyzed and are thus made available to the executive for rapid information and decision.

In the following one simple case of the design of such a diagram (Fig. 3) is given with the statistical data. Given:

Expected Uniform Average Weekly Production Rate: 270,000 barrels.

Time: 6 weeks.

Total Expected Production at the End of Sixth Week: 1,620,000 barrels.

ACTUAL PRODUCTION, PER WEEK ENDING

Actual Production During the Week Ending in Barrels		Cumulative Barrels
January 5	227,000	227,000
January 12....	233,000	460,000
January 19....	211,000	671,000
January 26....	237,000	908,000
February 2 ...	231,000	1,139,000
February 9 ...	246,000	1,385,000

The actual production line shows that the production during the entire period has been about 15 per cent. behind the expected output. Suppose, to show the universality of the diagram, production would have been according to the next table:

Actual Production During the Week Ending in Barrels		Cumulative Barrels
January 5	170,000	170,000
January 12....	430,000	600,000
January 19	No production. Strike	600,000
January 26....	430,000	1,030,000
February 2 ...	320,000	1,350,000
February 9 ...	200,000	1,550,000

If these facts are plotted (as shown by light dotted line) the diagram will give the following analysis: On *January 5* only 60 per cent. of the expected output was produced.

On *January 12* the production rate was above normal and therefore the intersection with the "above normal line" indicates that 10 per cent. more than expected was produced.

On *January 19* the mills were not in operation on account of labor trouble. The parallel line indicating no production.

On *January 26* again about 95 per cent. of the expected output up to date is produced.

In this way all actual production phases against time and requirements, expected deliveries or needs can be graphically analyzed.

R. VON HUHN

WASHINGTON, D. C.

THE SPECIFIC CONDUCTIVITY OF WATER EXTRACTS OF WHEAT FLOUR[1]

THE attention of cereal chemists has long been attracted to the development of methods for determining the grade of flour and meals. As early as 1884 Girard[2] suggested a procedure for estimating the proportion of fibrous structures in a cubic millimeter of the material. Vidrödi[3] (1893) called attention to the close parallelism between the grade of Hungarian wheat flours and the percentage of ash which

[1] Published with the approval of the Director as Paper No. 123 Journal Series Minnesota Agricultural Experiment Station.

[2] Girard, A., *Ann. d. Chim. et de Phys.*, 6 ser., 3, 293, 1884.

[3] Vidrödi, *Ztschr. angew. Chem.*, 1893, 691.

they contained. Various other tests have been proposed for this purpose, and the most successful may be summarized as follows:

(*a*) The percentage of ash.

(*b*) The relative proportion of fiber and debris, as suggested by Girard[3] (1884), Buchwald[4] (1913), and others.

(*c*) The content of pentosans, as indicated by Koning and Mooj[5] (1914).

(*d*) The relative change in color resulting from the addition of water and subsequent exposure to the air, a procedure making use of this color change having been patented by Hein[6] (1910).

(*e*) The catalase activity, as developed by Wender and Lewin[7] (1904), Miller[8] (1909), and others, and discussed in a paper by the writer[9] (1918).

(*f*) The comparative color of the dry flour, particularly after compression on a slab, the procedure being commonly known as the Pekar test.

The percentage of acidity, and of the soluble proteins and carbohydrates ordinarily diminishes with increasing refinement and "grade" of wheat flour. There are many exceptions to this rule, however, due to unsoundness of the wheat, or decomposition of certain flour constituents subsequent to milling, which may result in increasing the percentage of one or all of these groups of substances. The ash content is apparently more generally employed for detecting the relative grade of wheat flour than any other tests mentioned, with the possible exception of color. The latter is objectionable as a test because of the difficulty of expressing the results numerically. While certain instruments have been suggested for this purpose their use is not common.

[4] Buchwald, J., *Ztschr. ges. Getreidew*, 5, 50, 1913.

[5] Koning, C. J., and Mooj, W. C., Jr., *Chem. Weekblad*, 11, 1064–66, 1914.

[6] Hein, G., German Patent 250,413, November 13, 1910.

[7] Wender, N., and Lewin, D., *Oester. Chem. Z.*, 7, 173–175, 1904.

[8] Miller, M., *Ztschr. ges. Getreidew.*, 1, 194–200; 214–222; 238–244, 1909.

[9] Bailey, C. H., *Jour. Biol. Chem.*, 32, 539–545,

The almost universal use of the ash content in this connection suggested to the author that variations in these mineral constituents might be accompanied by corresponding variations in the electrical conductivity of water extracts of the flours. This could be postulated, if Swanson's (1912) suggestion that the principal inorganic elements of the ash, potassium and phosphorus are present in part in the water extract as potassium phosphate is correct. To ascertain whether or not such a relation existed, a series of flour samples was collected from a Minnesota flour mill, representing each of the flour streams. There were five break flours, three sizings flours, seven middlings flours, two tailings and three low-grade flours, in addition to the patent, clear, and red-dog flours marketed by the mill. These were employed in the conductivity studies because they afforded a progressive series from the standpoint of grade, with wide differences between the extremes. With the assistance of Miss Anna Peterson the effect of several variations in the technique and method were studied, and it was observed that the temperature at which the extraction was conducted was of greatest significance. The conductivity of extracts maintained at 40° during the period of extraction was materially greater than that extracted at 0°. With a certain flour these values for $\kappa \times 10^{-4}$ at 30° for extracts prepared at 40° and 0° were 4.82 and 6.00 respectively. The proportion of flour to water in the mixture during extraction was of importance, and a ratio of 1 part of flour to 10 parts of water was deemed most satisfactory. The treatment of the extract must be uniform and there was the least variation in the results when the extract was clarified by centrifuging for a few minutes, followed by filtration of the supernatant liquid. If the suspension of flour in water was placed in the conductivity cell without first filtering it, the conductivity gradually increased as the flour particles settled out of suspension. The period of extraction was of less significance than was anticipated, and 15 minutes' continuous shaking in a thermostat at the desired temperature

yielded an extract of practically the same conductivity as 1 hour's extraction.

The method adopted in testing the series of flour samples was essentially as follows: 10 grams of flour were shaken up with 100 c.c. of carefully prepared conductivity water in a Jena glass flask, and the mixture maintained in an ice bath at 0° for one hour. During this time the flask was shaken vigorously every 10 minutes. The contents of the flask were then placed in a tube and whirled for about 5 minutes in a large centrifuge. The supernatant liquid was filtered, returning through the filter until clear, and clear filtrate placed at once in the conductivity cell. The latter was immersed in a water thermostat at 30° and brought to temperature. The conductivity was determined in the conventional manner, the usual and necessary precautions being taken to insure accurate results.

The series of conductivity measurements shown in the following table were made with the collaboration of Mr. E. H. Doherty. The samples have been classified by groups as they are known to the miller. If these are rearranged in order of their ash content it will be found that with the exception of one group, and a single member of another group, the conductivity parallels the ash content. The group which presents the exception is the break flours, four of the five having lower conductivity values than would be expected from their ash content. The large proportion of variation in this group of flours suggests the operation of some factor in the break flours which does not appear in the other flours. The only other variation from the otherwise uniform parallelism between the percentage of ash and conductivity of the water extract is found in the third low grade. The conductivity here is lower than would be computed from the ash content. The data at hand do not indicate the exact reason for these relatively small deviations.

The possible value of this test of flour grade is indicated by this preliminary investigation. The determinations can be made with ease and speed when the equipment is assembled, and the technique acquired. We propose to carry

SPECIFIC CONDUCTIVITY OF FLOUR EXTRACTS AT 30°

Grade of Flour	Conductivity $\kappa \times 10^{-4}$	Ash, Per Cent.
First break	6.15	0.41
Second break	5.69	.34
Third break	5.78	.34
Fourth break	6.83	.91
Fifth break	9.56	1.50
First sizings	5.25	.53
Second sizings	5.49	.58
Third sizings	6.91	.71
First middlings	4.61	.38
Second middlings	4.51	.39
Third middlings	4.50	.38
Fourth middlings	5.18	.44
Fifth middlings	5.25	.53
Sixth middlings	6.11	.62
Seventh middlings	6.30	.67
First tailings	7.71	.97
Second tailings	9.18	1.27
First low grade	6.72	.79
Second low grade	7.59	.93
Third low grade	7.53	1.07
Patent	5.21	.45
Clear	7.71	.90
Red dog	14.98	2.53

the study farther when research of this character can properly be resumed. In the interval it seemed advisable to present these findings, that they may be applied if the method proves to be as well suited to this purpose as appears at this time.

C. H. BAILEY
DIVISION OF AGRICULTURAL BIOCHEMISTRY,
UNIVERSITY FARM, ST. PAUL, MINN.

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE North Carolina Academy of Science held its seventeenth annual meeting at the State Normal College, Greensboro, on Friday and Saturday, April 26 and 27, 1918. The executive committee met at 2:10 P.M. on Friday and passed on the business matters of the academy. The reading of papers was begun at 2:45 P.M. and continued until 5 P.M., when adjournment was had. At night owing to the absence of President W. A. Withers, due to serious illness in his family, the presidential address on "Gossypol" had to be omitted. How-

ever, Professor W. C. Coker gave two papers with lantern-slide illustrations—"*Azalea atlantica* and variety" and "A visit to Smith's Island." Smith's Island is situated at the mouth of the Cape Fear River and is of especial interest because it is the northern limit of various subtropical forms, particularly the palmetto palm. The academy then adjourned to another building where it was tendered a reception by the faculty of the college and the senior students in the science and home economics courses.

The academy met in annual business session at 9:10 Saturday morning. The minutes of the last meeting were read and approved, as were the reports of the Secretary-Treasurer and various committees, especially that on the teaching of science committee was continued for another year. The membership on January 1, 1917, was reported to be in the high schools of North Carolina. This latter 88. During the year 13 members were lost by resignation, removal from the state, and other causes, and ten new members were elected, bringing the membership on January 1, 1918, to 85. Five new members were elected at this meeting. An invitation from Trinity College, Durham, for the academy to be its guest at the next annual meeting was accepted.

The following officers were elected for 1918–19:

President—E. W. Gudger, State Normal College, Greensboro.

Vice-president—H. B. Arbuckle, Davidson College, Davidson.

Secretary-Treasurer—Bert Cunningham, Trinity College, Durham.

Additional Members Executive Committee—George W. Lay, St. Mary's School, Raleigh; Miss Gertrude Mendenhall, State Normal College, Greensboro; J. J. Wolfe, Trinity College, Durham.

At the close of the business meeting, President Foust, of the college, informally welcomed the academy to the college. Next a joint meeting was had of the academy and the North Carolina Section of the American Chemical Society, at which the chemical papers of general interest from the chemists' program were read. Following this, each organization went into separate session. Adjournment was had at 12:50 and the visiting scientists as guests of the college were entertained at luncheon in the college dining hall. Reconvening at 2 P.M., the reading of papers was concluded at 2:30, at which time the academy adjourned.

The effects of the war on the academy were plainly to be seen in the smaller number of papers than usual presented, and in the large number of resignations sent in or pending due to service in the army. Out of a total enrollment on January 1, 1918, of 85, 9, or over 10 per cent., are in the war, and others, particularly chemists, have gone north to engage in war work. However, there was an attendance of 24, and the meeting was a very enthusiastic and thoroughly enjoyable one. The smaller number of papers made possible the considerable discussion which followed the reading of nearly every one. The following papers were presented, numbers 4, 7, 12 and 20 of which will appear in the current issue of the *Journal* of the Elisha Mitchell Scientific Society.

The war work of American physicists: C. W. Edwards. (Read by the Secretary.)

Some important but largely neglected scientific facts: George W. Lay.

Symptoms of disease in plants: F. A. Wolfe.

The sun's eclipse, June 8, 1918: question: John F. Lanneau.

Entrance requirements in science at the State Normal College: E. W. Gudger.

Extension of the range of Prunus umbellata into North Carolina: J. S. Holmes.

Eliminations from and additions to the list of North Carolina reptiles and amphibians: C. S. Brimley. (Read by the Secretary.)

Azalea atlantica and variety: W. C. Coker.

Notes on the magnetic compass: T. F. Hickerson.

Variation within the individual sponge towards types of structure characteristic of other species and genera: H. V. Wilson.

New or interesting North Carolina fungi: H. C. Beardslee.

Herpetological fauna of North Carolina compared with that of Virginia: C. S. Brimley. (Read by the Secretary.)

Further occurrence of cross conjugation in Spirogyra: Bert Cunningham. (Lantern.)

A visit to Smith's Island: W. C. Coker. (Lantern.)

Some methods and results of a plankton investigation of Chesapeake Bay: J. J. Wolfe and Bert Cunningham. (Lantern.)

Mineral fertilizers; their mode of occurrence and distribution in North Carolina: Collier Cobb.

Notes on buds: E. W. Gudger.

Recent changes in Currituck Sound: Collier Cobb.

The return shock due to lightning: Andrew H. Patterson.

Report of investigations on the cause of death of matured chicks in shell in artificial incubation: H. B. Arbuckle.

E. W. Gudger,
Secretary

Date of issue.	Date of issue.	Date of issue.
21-3-61		